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*Ingenuas didicisse fideliter artes*

*Emollit mores.*——

*Asperitatis et invidiæ corrector et iur.*

To have learned the liberal arts thoroughly, softens the manners, and operates as an excellent corrector of ill-nature, envy, and anger.

OVID. HOR.

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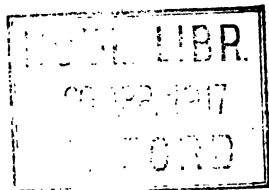
Καὶ ΒΡΕΦΟΣ διδάσκεται  
Λέγειν, ἀκούεινδ', ὅν μάθῃσιν οὐκ ἔχει  
"Ἄδ' αἰ μάθη τις, ταῦτα σέξισθαι φίλῃ  
Πρὸς γῆρας· οὕτω ΠΑΙΔΑΣ ΕΥ ΠΑΙΔΕΥΕΤΕ.

EURIPIDES.

---

Ε' n the INFANT learns  
To form new Notions, and to utter them;  
And what he learns, he faithfully retains  
When he is old :—INSTRUCT THEN YOUR  
CHILDREN WELL.

---



## PREFACE.

---

IT was said of one of the ancients—I think it was Socrates, or his disciple Plato—that he brought Philosophy down from heaven, to dwell among men upon earth.

THE same may, in some measure, be affirmed of all those who successfully endeavour to render the ARTS and SCIENCES, which were formerly wrapt up in the learned languages, and in technical terms, intelligible to the bulk of mankind, or to those who have not had the advantage of a liberal education.

SUCH was, no doubt, the design of Dr. Turner in the present publication; and if he did not render it more copious and comprehensive, it was neither for want of inclination nor ability, but merely from a desire of confining the size of the book, as well as its price, within as narrow limits as possible.

He intended however, had he lived, to have made many additions to the present impression. These he proposed chiefly to introduce in the article of Physics or Natural Philosophy, convinced, that what he had already said on Metaphysics and Moral Philosophy was as much as was necessary or proper for those, for whose use the book was expressly composed.

THE Editor of the fourth Edition had an opportunity of being perfectly acquainted with the Doctor's sentiments in these particulars, and endeavoured to execute his intentions in the best manner he could.

THE Additions, that were therein made to the work, were interspersed through various parts of it; but will chiefly be met with in the APPENDIX at the end, where the reader will see two pretty long articles; the first containing an Abridgment of Natural History, the second representing the present state of Electricity; a science almost entirely new, and totally unknown to the ancients; and which, though it had so long escaped the researches of mankind, is yet supposed to be the real source of many of those phænomena or appearances, which were formerly thought to be owing to a very different cause.

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# ADVERTISEMENT

TO THE  
*FIFTH EDITION.*

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THE liberal Patronage of a generous Public, which has rewarded the Proprietor's Exertions by the rapid Sale of four large Impressions, has called forth his gratitude in causing the present Edition to be revised and improved. In the Articles of Physics, (particularly on Volcanoes) Cosmography, Geography, and History, many Improvements have been made, as a very slight Comparison must fully demonstrate. No Care or Expence have, in short, been wanting to render it still more deserving of that general Approbation, with which it has been sanctioned through the former Editions, by the Corrections, Additions, and Advantages of the present.

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---

AN  
ABRIDGMENT  
OF THE  
ARTS AND SCIENCES.

---

LESSON I.

OF RELIGION.

“The fear of the Lord is the beginning of wisdom : a good  
“understanding have all they that keep his command-  
“ments.”

DAVID.

“Be particular not to neglect religion in the education of  
“your children. In vain will you endeavour to conduct  
“them by any other path. If *they are dear to you*, if you  
“*expect from them credit and comfort*, from religion must  
“be derived their happiness and your own.”

FATHER GERDIL.

---

**R**ELIGION ! foother of all our keenest sor-  
rows, source and refiner of all our real joys !  
shed thy heavenly influence on our souls ; direct,  
animate, and crown all our pursuits ; pervade and  
consecrate all our thoughts, words, and actions ;

B

or

or we can never answer the design of God in our creation; we fall short of true happiness in this life, and we sink to the compleatest wretchedness in that which is to come\*.

Q. What is religion?

A. A worship rendered to the Divine Being after that manner we *conceive* to be most agreeable to his will, that so we may procure his favour and blessing, and avoid his anger and displeasure; and is either *true* or *false*, *pure* or *corrupted*.

Q. How do you divide true religion?

A. True religion admits of three divisions; 1st, the religion of nature; 2d, the religion of the Jews; 3d, the religion of Christians.

Q. What is natural religion?

A. As far as our notions of a divine Being proceed from the ideas we have from the light of nature and reason.—Man has been defined a rational creature; but some of the brute creation, such as a horse, dog, elephant, &c. discover such traits of reason, as shew it to be, by no means, peculiarly and exclusively confined to man. He is therefore, and perhaps with more propriety, called a *religious* animal, since no creature, except man, appears to have any sense of religion.

Dr. Ash.

Q. On

**Q.** On what is the religion of the Jews founded?

**A.** On the Old Testament, and the law given by Moses to the tribes of Israel.

**Q.** Who is the author of the Christian religion?

**A.** The Son of God, who left the bosom of the Father, and all his glories there, to dwell in flesh and blood: he became the child of a poor maid in Galilee;—when grown up, he appeared as a young carpenter, and sweat and laboured in the trade of his father Joseph;—he travelled on foot to preach his divine gospel, when he might have been borne on the wings of angels;—he was content with mean lodgings in the tents of poor fishermen in Galilee, the most contemptible country of the Jews;—and sometimes the Lord of glory had not where to lay his head.—An obscure life on earth veiled the Majesty of the King of Heaven.—Such was the amazing humility of the Son of God, the blessed Author of Christianity; such the example left us by the meek and lowly Jesus.

**Q.** How many false or spurious religions are there?

**A.** Two;—Paganism and Mahometanism.

**Q.** What is Paganism?

**A.** The religion of the Pagans, or Heathen nations;—and, because they represent the deity

under several forms or idols, it is called idolatry, or image worship.

Q. From whom has Mahometanism its rise?

A. From the impostor Mahomed, who appeared in the seventh century ;—his whole doctrine is a ridiculous jumble of Heathenism and Judaism, with a mixture of Christian heresies, and is contained in the rhapsody of the Alcoran.

Q. What do you mean by pure religion?

A. That which is founded on the word of God only?

Q. What do you mean by a corrupted religion?

A. That which is full of human conceits and devices?

Q. Of what advantage is an exact observance of religion to a state?

A. Very great; it inspires honesty in every one, justice in princes, fidelity in subjects, integrity in magistrates, good faith in commerce, and union in marriage.

## LESSON II.

## OF THE ARTS AND SCIENCES.

“ The *taking a taste of every sort of knowledge* is necessary  
 “ to form the mind, and is the only way to give the un-  
 “ derstanding its due improvement to the full extent of its  
 “ capacity.”

LOCKE.

*Quest.* WHAT is science ?

*Anf.* A certain and evident knowledge of something.

*Q.* What is art ?

*A.* Art is the way of doing a thing surely, readily, and gracefully ?

*Q.* How are the arts divided ?

*A.* Into those that belong to the sciences, and those that are called mechanical arts.

*Q.* What are the arts that belong to the sciences ?

*A.* Philosophy, rhetoric, grammar, mathematics, astronomy, painting, music, and sculpture. These are called the *liberal arts*.

*Q.* Why are they so called ?

*A.* Because the ancients allowed them to be studied only by the *Liberi* or free persons.

Q. How many sciences are there ?

A. Eight principal ones;—1st, Theology ; 2d, Philosophy ; 3d, Jurisprudence ; 4th, Medicine ; 5th, Rhetoric ; 6th, Grammar ; 7th, Poetry ; and the 8th, Mathematics.

### I. *Of Theology.*

Q. What is theology ?

A. That science which contemplates the nature of God, and divine things.

Q. Whence is the word theology derived ?

A. From two Greek words, viz. *θεος*, God, and *λογος*, *word* ; that is, the *word of God*.

Q. How may the existence of God be proved ?

A. What is necessary to be known of God is manifest in the works of the creation. The heavens declare the glory of God, and the rich furniture thereof. The sun, the moon, and stars, shew themselves to be his handy-work. There is no nation on the face of the whole earth where their voice is not heard, for it is gone through all the earth, and their word to the end of the world.

Q. To whom was the title of theologian first given ?

A. To ST. JOHN, who has by that name been distinguished from the other three Evangelists, because

cause they only wrote the history of the life of Jesus Christ, but St. John wrote his gospel to establish his eternal divinity (as the word of God), and his incarnation.

## II. *Philosophy.*

Q. What is philosophy ?

A. The study of nature and morality, as they are founded upon reason.

Q. What is the etymology of the word philosophy ?

A. It is compounded of the two Greek words *φιλια* love, and *σοφια* wisdom or knowledge.

Q. Into how many parts is it divided ?

A. Four ; logic, morality, physics, metaphysics.

### I. *Logic.*

Q. What is logic ?

A. The art of using reason well in our enquiries after truth, and the communications of it to others.

Q. In what does this art consist ?

A. In the reflections made by men upon the four principal faculties of their mind, perception, judgment, reasoning, disposition.



## II. *Morality.*

Q. In what are we instructed by morality ?

A. It gives us rules for our behaviour, manners, and conduct, whether in public or private life, and is properly called *Ethics*, from the Greek word *ἠθικός*, and *morality*, from the Latin word *mos*, plural *mares*, both signifying manners or behaviour.

## III. *Physics.*

Q. From what is the word physics derived ?

A. From the Greek word *φύσις* *nature*, or *φυσική* *natural*.

Q. Of what does it treat ?

A. Of all natural things ;—it teaches us to explain all the phenomena of the heavens and earth.—  
And,

### 1. *Of Meteors.*

Q. What is a meteor ?

A. A meteor is whatever is engendered in the air which surrounds us, and generally puts on the appearance of fire or flame, so as to become visible to us.

Q. What

Q. What is the air ?

A. A transparent, invifible, and impalpable liquid matter, encompassing on all parts the terrestrial globe. The air, by experiments, has been found to be 914 times lighter than water.

It is this, even near the surface of the earth, where it is heaviest : in the higher regions it is still lighter. For the air is composed of a high, middle, and lower region.

The air of the higher region is more subtile and more cold than that of the middle ; and that of the middle is finer than the lower.

The weight of a column of air, reaching from the surface of the earth to the top of the atmosphere, is equal to that of a column of water, of the same diameter, 33 feet high ; for so high, and no higher, will water rise in a pump, by the pressure of the external air, after the air within the pump has been extracted by the piston or sucker. Now the weight of a square column of water, 1 foot thick, and 33 feet high, is 2160 pounds ; so that a man of a middling size, the surface of whose body is about 14 square feet, sustains a pressure of air of 30240 pounds, when the air is of a moderate gravity ; a pressure that would be insupportable, and even fatal to him, were it not that it is equal on every part, and counterbalanced by the

spring of the air within him, which is diffused through the whole body, and re-acts with an equal force against the outward pressure. Hence it is that a column of mercury in the barometer, from the same principle, does not rise higher, on a medium, than 29 inches and a half, its specific gravity to that of water being nearly as 14 to 1.

*Q.* What is the composition of meteors?

*A.* Vapours and exhalations.

Vapours are particles of water that mingle with the air.

Exhalations are particles of all the different terrestrial bodies that rise into the air, sulphurs, salts, bitumens, and other bodies of different natures, more or less combustible, solid, or heavy.

## LESSON III.

2. *The Wind.*

Q. **W**HAT is the wind?

A. Nothing else but the air put violently into motion; and this occasioned chiefly by means of heat. For, when any part of the air is heated by the sun, or otherwise, it will swell, and thereby affect the adjacent air: and so, by various degrees of heat in different places, there will arise various motions of the air.

When the air is much heated, it will ascend towards the upper part of the atmosphere, and the adjacent air will rush in to supply its place; and therefore there will be a stream or current of air from all parts towards the place where the heat is. And hence we see the reason why the air rushes with such force into a glass-house, a tile-kiln, or towards any place where a great fire is made: and also why smoke is carried up a chimney, and why the air rushes in at the key-hole of the door, or any small chink, when there is a fire in the room. So in general we may take it for

granted, that the air will press towards that part of the world where it is most heated.

2. How are the winds divided?

A. Into four principal ones, the NORTH, SOUTH, EAST, and WEST, which receive their name from the four principal quarters of the world.

The Frigid Zone is the parent of the North Wind, which is consequently the coldest.

The South Wind is the warmest, particularly in the summer; because it comes from the Torrid Zone, over countries hotter than *ours*.

The East Wind is the driest, because it comes across the vast continent of Asia, but little watered by rivers or seas.

The West Wind is generally damp, and often blows us rain; because, as it crosses the great Atlantic Ocean, it attracts a great quantity of vapours.

When these impetuous winds happen to meet, the greatest inconveniences follow. The sulphureous exhalations from the south, torrents of nitre from the north, and watery vapours from every side, become, indiscriminately, blended together in one confused mass.—From hence proceed tempests, thunder, rain, hail, and whirlwinds.

The velocity of wind is at the rate of 50 or 60 miles an hour in a great storm ; that of a common brisk wind is about 15 miles an hour ; and some winds move not even one mile in that space of time.

A person, therefore, on horseback, and even sometimes on foot, may be said to outstrip the wind ; for if he moves faster than the wind, which is very possible, he will have a wind in his face, though the motion of the air be really the contrary way.

The air is often seen to move in two contrary currents, and this almost always previous to thunder. The clouds in such a case are seen to move one way, while the weather-cock points another.

Red clouds appearing in the morning preface winds and rain.

### 3. *Clouds and Mists.*

Q. How are mists formed ?

A. Mists are those collections of vapours which chiefly rise from fenny moist places, and become more visible as the light of the day decreaseth.

Q. What are clouds ?

A. Clouds are nothing else but a collection of misty vapours, suspended aloft in the air, and  
soaring

soaring on the wings of the wind in a state so condensed as to appear dark.

Q. Pray how high do you suppose the clouds to fly?

A. From about a quarter of a mile to a mile. It is common for persons, by climbing very high mountains, to get above the clouds, and see them swim beneath them, and, as it were, brushing the side of the mountains they are on.

Q. Whence come the various figures and colours of the clouds?

A. The wonderful variety in the colours of the clouds, is owing to their particular situation with regard to the sun, and the different reflections of his light; the various figures of the clouds result from their loose and voluble texture, revolving into any form according to the different force of the winds.

#### 4. *Rain.*

Q. What is rain?

A. Nothing but thick clouds condensed by the cold, which, by their own weight, fall upon the earth in small quantities, called drops of water.

Those small clouds, sometimes seen very high heaped one upon the other, presage rain very soon.

When

When the horizon, at the rising or setting of the sun, appears pale and yellowish, it is a sign of the air being full of vapours, and threatens bad weather.

But when it is of a light red at those times, there are but few vapours in the air, and fine weather may be expected.

If the cloud that melts is greatly rarified, and its particles, in falling, meet an air moderately warm, these drops will be so small, that they will not compose rain, but rime only.

#### 5. *The Dew.*

*Q.* From what is the dew produced?

*A.* From a quantity of particles of water extremely subtil, that float about in a calm and serene air in form of vapours; these, being condensed by the coldness of the night, lose by degrees their agitation; and many uniting together, fall in the evening in small invifible particles, like an extremely fine and delicate rain, which continues but a short time, and is seen in drops of water like pearls upon leaves and herbs.

#### 6. *Snow.*

*Q.* How is snow formed?

*A.* Snow is produced thus: in winter the regions



gions of the air are intensely cold, and the clouds finding this great cold on every side, quickly pass from that state of condensation which might reduce them to rain, into that which is able to reduce them to ice; so that in winter, as soon as the clouds begin to change into very fine drops of water, each of these small particles freeze, and touching each other, form flakes of snow.

Q. Why are these flakes so light, and the snow so white?

A. The small intervals that the flakes leave between them, like so many pores, filled with a subtle air, are the cause of their lightness.

The snow is white, because the small particles of ice that compose those flakes being hard, solid, transparent, and differently arranged, they reflect to us the light from all parts.

## LESSON IV.

1. *Of the Hail.*

**H**AIL is formed when the parts of the cloud, beginning to fall, meet in their descent a very cold air; which freezes them, and form small bits of ice, which are very near the figure and size the drops of water would have been had they fallen.

2. *Thunder and Lightning.*

Q. What is thunder?

A. A noise heard in the air, most frequently in the summer. Thunder is the most wonderful of all meteors.

Q. What is the cause of this meteor?

A. Thunder is caused by the nitrous or sulphureous particles of the clouds, taking fire through the fierceness of their motion, occasioned by strong winds, and bursting with a tremendous noise, which is preceded by a flash of fire, or lightning.

The reason we do not hear the dreadful noise of the thunder, so soon as we see the lightning, is,

is, because sound is longer in arriving to our ears, than light to our sight.

Light moves almost instantaneously : sound moves no more than 1142 feet in a second. That light moves much faster than sound, any one may satisfy himself by observing a gun discharged at a distance, for he will see the fire long before he hears the sound.

The continuation and repetition of the sound is caused by a kind of echo formed in the clouds, to which many hard bodies upon the earth may contribute, which return those rollings we hear after a great clap of thunder.

Q. I have heard talk of thunder-bolts and their strange effects, pray what are they ?

A. What is called a thunder-bolt is a solid and most rapid flame, which, with incredible swiftness, flies from the clouds to the earth, and through every thing standing in its way, being interrupted by nothing. It sometimes kills men and animals, burns and overthrows large trees and buildings, and sets fire to every thing in its way.

### 3. *Of the Iris or Rainbow and Halos.*

Q. What is the Iris or Rainbow ?

A. A

*A.* A beautiful arch in the heavens, ornamented with various colours, that is only seen when the spectator turns his back to the sun, and when it rains on the opposite side. Its colours are, beginning from the under part, violet, indigo, blue, green, yellow, orange, red.

*Q.* What was the opinion of the ancients concerning this meteor?

*A.* Its beautiful colours struck antiquity with amazement. To the philosophers Pliny and Plutarch, it appeared as an object which we might admire, but could never explain.—The priests always preferred the wood on which the rainbow had appeared to rest for their sacrifices, vainly supposing that this wood had a perfume peculiarly agreeable to their deities.

*Q.* Please to explain a little how the rainbow is produced, and how it acquires its beautiful and wonderful form.

*A.* Some philosophers of the obscure ages began to form more just conceptions concerning this meteor; but as they were ignorant of the true causes of colours, they left the task unfinished for our incomparable Newton to complete.—It is made, according to his theory, by the rays of the sun being refracted by the drops of falling rain or mist, and thence reflected to the spectator's eye.

All

All the colours of the rainbow may be produced by making the rays of the sun pass through a transparent prism of glass.

Q. You have said nothing of the rainbows that sometimes appear by night in the moonshine ;— what think you of them ?

A. The *lunar* rainbow is formed exactly in the same manner, by the bright beams of the moon striking upon the bosom of a shower.

Q. How do you account for that lucid ring we see diffused round the moon, called an halo ?

A. As this always appears in a *rimy* or *frosty* season, we may suppose it occasioned by the refraction of light in the frozen particles of the air.

#### 4. *The Aurora Borealis.*

Q. What is the cause of the Aurora Borealis, or that shining light which is often seen by night in the heavens, and which the vulgar call northern lights or streamers ?

A. They may be the result of certain nitrous and sulphureous vapours, thinly spread through the atmosphere above the clouds, where they ferment, and taking fire, the explosion of one portion kindles the next, and the flashes succeed one another, till all the vapour is set on fire, the streams  
whereof

whereof seem to converge towards the zenith of the spectator, or that point of the heavens which is immediately over his head.

The Aurora Borealis, or Northern Lights, is a very uncommon phænomenon in countries near the pole ; but they were not much seen, or, at least, observed in England till the month of March 1716. Since that time, however, they have been, and still continue to be, very frequent.

### 5. *Earthquakes.*

*Q.* What is an earthquake?

*A.* A sudden motion caused by the inflammation of some sulphureous and bituminous exhalations contained in the caverns of the earth, not far from its surface.—In the southern countries, earthquakes are very frequent.

Naturalists attribute them both to air and water, and that very truly.—To comprehend this more easily, it must be remarked, that the surface of the earth is, as it were, a shell, beneath which there are an infinite number of cavities and canals, sufficient to contain a considerable quantity of air, water, &c. which, attempting to rush out violently, causes those extraordinary tremblings of the earth. Others, however, are of opinion, that  
earth-

earthquakes are not so much owing to the explosion of any sulphureous matter; or the expansion of any winds or vapours in the bowels of the earth, as to the electric matter rushing along the surface of it, and perhaps communicating with that within.

Dr. Stukely was the first who advanced this opinion, in support of which he has urged many specious arguments. In the first place, he says, that in the earthquake which happened at London, on the 20th of September, 1750, and which affected an extent of country 30 miles in diameter, had it arisen from a subterraneous explosion, it must have moved an inverted cone, or, which is the same thing, a solid body of earth in the shape of a sugar-loaf turned upside down, whose base was 30 miles, and its axis, or depth, 15 or 20 miles; an effect which, he affirms, no natural power could produce.

Nay, in the great earthquake, which happened in Asia Minor, A. D. 17, which destroyed thirteen large cities, and which affected an extent of country 300 miles in diameter, had it proceeded from a subterraneous cause, it must have moved an inverted cone of solid earth 300 miles in diameter, and upwards of 900 in circumference, and about 200 in depth, or axis; which, Stukely says, all the

the gunpowder which has been made since the invention of it, would not have been able to stir, much less any vapours, which could be supposed to be generated so far below the surface.

Add to this, that ships sailing in the bottomless ocean are affected by an earthquake, in the same manner as if they were standing upon dry land.— They seem to feel as if they had struck upon a rock, or as if something had thumped against their bottom. But this could never be the case, did the earthquake arise from a subterraneous explosion at the bottom of the sea; for that, at the utmost, could only produce a gradual swell of the water, and not a sudden shock, like a stroke of electricity, as it now does.

Q. Are there not many subterraneous places in the earth from which issue torrents of smoke and of flames, rivers of melted metals, and clouds of ashes and stones?

A. Yes; they are called *volcanos*; the most famous of which are those of mount *Etna* in Sicily, *Vesuvius* in Naples, and *Ecla* in Iceland.

In an eruption from the second of these, the two cities of Pompeii and Herculaneum were buried by the lava, and lay concealed in that state for several ages, till they were lately discovered. Pliny the elder, too, the famous naturalist, perished on the



the occasion. Pliny the younger, author of the epistles that go by his name, has given us an account of this catastrophe in one of his letters.

The bowels of these burning mountains contain sulphur, bitumen, and other inflammable matter, the effects of which are more dreadful than those of thunder or of gun-powder, and they have in all ages astonished mankind, and desolated the earth.

There was a most dreadful eruption of Etna, consisting of liquid fire and burning matter, in 1693; it destroyed 15 or 16 different towns, 18 estates, and more than 90,000 souls.

Within the last thirty years there have not been fewer than nine several eruptions of Mount Vesuvius, besides many preceding ones, some of which have been very accurately related by Sir William Hamilton.

The last, which happened on the night of the 15th of June, 1794, was preceded by earthquakes, first opening in two places, from which issued columns of black smoke, mixed with liquid inflamed matter; and afterwards more mouths were opened. Explosions, louder than thunder, with sharp reports, as from the heaviest artillery, proceeded from all of them. The lava flowed about four miles in four hours; the greatest part of  
Torre

**Torre del Greco**, a mile from Portici, was thereby destroyed, or so much injured as to be uninhabitable.

Though 17,000 inhabitants were driven out of the town of Torre del Greco, not more than fifteen lives were lost there. A promontory of 70 feet high in some places, and about a quarter of a mile broad, has been formed by the lava which ran over the greatest part of this town into the sea.

The lava covered and totally destroyed above 5000 acres of rich vineyards and cultivated land; and the temporary damage done to the vineyards on the Somma side, and for many miles round, by the ashes, is immense. In some places they are not less than four feet deep.

## 6. *Of Tides.*

2. Pray what is meant by the tides, or alternate flux and reflux of the sea?

A. As rivers flow and swell, so also does the sea: like them it has its currents, that agitate its waters, and preserve them from putrefaction.— This great motion of the ocean is called its tides. The waters of the ocean have been observed regu-

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larly

larly from all antiquity to swell twice in about four and twenty hours, and as often to subside again.

In its influx the sea generally rises for six hours, when it remains, as it were, suspended, and in equilibrio, for about twelve minutes; at that time it is called high water.

In its reflux the sea falls for six hours, when it remains, as it were, in a like manner, suspended, and in equilibrio, for about twelve minutes; at that time it is called low water.

Q. What is the cause of these wonderful appearances?

A. We are told that *Aristotle*, despairing to discover the true cause that produced them, had the folly, in spite of his philosophy, to throw himself headlong into the sea.—According to our great *Newton*, they are occasioned by the attraction of the moon; for the waters immediately underneath the moon will be attracted up in a heap, whilst the waters on the opposite side the earth, being but feebly attracted, will be very light;—if they be very light, they also will rise, and all the neighbouring waters flowing into that place, they will swell into an heap, or mountain of waters, pointing to the opposite parts of the heavens. Thus does the moon, in once going round the earth in  
twenty-

twenty-four hours, produce two tides or swells, and consequently as many ebbs.

These tides must flow from east to west, for they must necessarily follow the moon's motion, which is from east to west.

This course of the tides, however, is sometimes interrupted by continents, and other large tracts of land. The tide, for instance, in the Indian ocean, being stopped by the eastern coast of Africa, must necessarily flow south, towards the Cape of Good Hope, which having passed, it then runs northward along the western coast of Africa, and that of Spain, Portugal, and France, till it enters the English channel. It there meets the tide from the German ocean, running a contrary way, and is necessarily stopped, which produces a very great swell of water.

These two tides thus flowing in opposite directions, and meeting a little irregularly, have sometimes occasioned two tides, the one immediately after the other, in the river Thames. Both these proceed from the same natural cause, and consequently are very easy to be explained, though the phenomenon has been looked upon as a prodigy.

As to the tide of rivers, it must always flow in a direction directly the reverse of their natural stream; for the waters of the sea being higher,

they must necessarily flow into them, and make their waters flow back or regurgitate. The tide of the Thames, and of all the other rivers on the eastern coast of England, must flow westward : the tide of the Severn, and of all the other rivers on the western coast of England, must run eastward ; and so of the rest.

**LESSON**

## LESSON V.

1. *Of Metaphysics.*

**Q.** WHAT is meant by metaphysics?

**A.** A science more sublime than physics.

**Q.** What is the difference of these two sciences?

**A.** Physics treats of natural things, and judges of them from experience.

Metaphysics is applied only to the contemplation of God, angels, and spiritual things, and judges of them only by abstraction, and independent of material things.

2. *Jurisprudence.*

**Q.** What is jurisprudence?

**A.** The knowledge of the rights, customs, ordinances, &c. necessary for the administration of justice, being derived from the two Latin words *jus*, right, and *prudentia*, knowledge or skill.

**Q.** How is right distinguished?

**A.** Into the *right*, or *law*, of *nature*, the *law* of *nations*, and the *civil law*.

Q. What is the law of nature ?

A. That which nature and reason have taught men ? as the power it gives to fathers and mothers over their children.

Q. In what does the law of nations consist ?

A. In public acts and statutes which provide for the public utility and necessity of the people, considered as a body corporate, and ordain and decree whatever relates to obedience and subjection, dominion and government, war and peace, contracts, divisions of lands, foundations of societies, and the constitution of cities, towns, and villages.

Q. What is the civil law ?

A. The civil law is that which is peculiar to any country or people, and administers that which arises from their particular situation, and special relations and circumstances. When this respects a city or borough town, it is called their *municipal* law. The professors of this sort of law are called civilians.

Q. Specify the several kinds of laws now in use in England.

A. The laws by which England is governed, are, 1<sup>st</sup>, the *civil law*, before-mentioned ; 2<sup>d</sup>, *common law*, containing a summary of all the laws, rights, and privileges of the people of England, in what is called the *magna charta*, or great charter

ter of English rights; 3d, *statute law*, consisting of statutes, acts, and ordinances of king and parliament; 4th, *canon law*, consisting of the canons of general councils, and national and provincial synods, with the decrees of popes, the judgment of ancient fathers, &c. used in ecclesiastical affairs; 5th, *martial law*, used in all military and maritime affairs; 6th, *forest law*, which relates to the regulations of forests, and the chase; 7th, to these may be added the *law of custom*, which is remarkable in some parts of England.



## LESSON VI.

1. *Of Medicine.*

Q. IN what does the art of medicine or physic consist?

A. In the knowledge of such disorders as the human body is liable to, and the nature of such drugs and medicines as are necessary to remove them when they happen. And the person who possesses this skill is called a physician.

Q. How may this knowledge of the human body be acquired?

A. By the help of anatomy.

2. *Of Anatomy.*

Q. What do you mean by anatomy?

A. I mean a dissection of the human body, which affords an easy method of examining all its parts; and to discover what tends either to impair or strengthen the constitution.

Q. How is medicine divided?

A. Into theoretic and practical. The theoretic is employed in contemplating the quality of remedies,

medies, or considering the nature of diseases ; the practical discovers, by experience, the particulars of each disease, and applies such remedies as are proper to promote a speedy cure.

### 3. *Surgery.*

Q. What is Surgery ?

A. Surgery (or chirurgery) is that useful branch of the healing art, which consists in the manual operations, with proper instruments, or other external applications, to wounds, bruises, &c. which are no inconsiderable parts of the profession ; and as its effects are more evident than those of medicine, it has always been much cultivated.

Q. What disorders demand the surgeon's care, and make the subject of his art ?

A. 1st, All kinds of *tumours*, or swellings ; 2d, *ulcers*, or running sores ; 3d, *fistulas* ; 4th, *inflammations*, or stumous disorders ; 5th, all kinds of *wounds* ; 6th, *gangrenes*, or mortifications ; 7th, *dislocations*, or disjoined limbs ; 8th, *fractures*, or broken limbs.

Q. What are the proper qualifications of a good surgeon ?

A. A good surgeon ought to be well skilled in anatomy, medicine, and other parts of learning ; a man of great experience, uncommon dexterity,

an unshaken courage, and steady hand, a clear sight, quick thought, and of an ingenuous and honest mind.

#### 4. *Of Pharmacy.*

Q. Inform me what the other part of physic called pharmacy is?

A. Pharmacy teaches the choice, preparation, and mixture of medicines. This science is no more than the profession of apothecaries. Pharmacy comes from the Greek word *pharmacon*, which signifies a remedy. The book, directing how such medicines are to be made, is called a *dispensatory*.

#### 5. *Of Chemistry.*

Q. What is Chemistry?

A. Another part of medicine that teaches to reduce mixed bodies, so as to know the parts, to separate the bad, to collect and refine the good.— Chemists have made discoveries of the highest use to physicians and surgeons.

6. *Of Botany.*

Q. What is understood by botany?

A. That other part of physic which treats of plants, herbs, and vegetables, and describes their nature, kinds, and uses in medicine, and other affairs of life.—The word botany is derived from the Greek word *botane*, which signifies an herb.—A book on this subject is called an herbal; and a professor of this art or knowledge is called a *botanist*, *herbalist*, or *sampler*.

Q. Is botany very necessary to a physician?

A. Yes; for it includes the knowledge of all medicinal plants, without which it would be impossible for him to use any of them, but at a very great hazard of the life of the sick person, or, at the least, doing him a great injury.

## LESSON VII.

*The Languages.*

Q. **W**HAT is language?

A. Language is a set or collection of sounds or notes made use of by any nation or people to express the ideas of their mind, and by this means to render their thoughts intelligible to each other; and this communication of our sentiments to others is called speech, or speaking.

Q. Whence comes the great number and diversity of languages?

A. From the building of the Tower of Babel, Genesis, chap. xi.

Q. How many original languages, or, as they are commonly called, mother tongues, are there in the world?

A. 1. The Hebrew; 2. the Greek; 3. the Latin; 4. the old Gothic.

Q. What are the properties of the Hebrew?

A. The chief properties of the Hebrew are, 1st, That its letters are twenty-two, of which we have a statement in the following table.

The

The Name:	num.	form	Final†.	lims.	Sound or Power.
Aleph	1	א			<i>abroad, as in war</i>
Beth	2	ב		ב	
Gimel	3	ג		ג	<i>hard, as in</i>
Daleth	4	ד		דך	<i>[give, get</i>
He	5	ה		הה	<i>e, as in where</i>
Vau	6	ו		ו וי	<i>u, as oo, w before</i>
Zain	7	ז			<i>z [a vowel</i>
Heth	8	ח		ח	<i>hard aspirate</i>
Teth	9	ט		ט	<i>th</i>
Yod	10	י			<i>i like ee</i>
Caph	20	כ	ך 500		<i>k or c hard, as</i>
Lamed	30	ל			<i>[come</i>
Mem	40	מ	ם 600		<i>m</i>
Nun	50	נ	ן 700		<i>n</i>
Samech	60	ס		ם	<i>sh</i>
Oin	70	ע		צ ע	<i>o long, as whole</i>
Pe	80	פ	ף 800		<i>p</i>
Jaddi	90	צ	ץ 900		<i>j soft, as in trea-</i>
Koph or Quoph	100	ק			<i>q or qu [sure</i>
Resh	200	ר			<i>r</i>
Shin or Sin	300	ש			<i>s</i>
Tau	400	ת			<i>t</i>

Of these letters five are vowels, namely, א, ה, ו, י, ע; all the rest are consonants.

\* That is, numeral power or import as an arithmetical mark.

† Letters thus written at the *end* of a word.

2d, That many words occur without any of the vowels, which may be pronounced as if a short *e* or *a* stood between the consonants; as דבר DBR, pronounce *Deber* or *Dabar*; פקר PQD, *peqed* or *paqad*. 3d, That most feminine nouns end in ך or ם, most others are masculine. 4th, That the plural masculine is formed by adding ם, and the plural feminine by adding ם to the singular.— 5th, That the verbs have only *two tenses*, *past* and *future*, and *two genders*, *masculine* and *feminine*. 6th, That Hebrew is read from the right hand to the left, and not from the left to the right, as the English and other western languages. 7th, That from the Hebrew sprang the Chaldee, the Syriac, the Arabic, the Samaritan, and the Ethiopic.— The Arabic is the most copious, having a thousand different words for a sword, five hundred for a lion, and two hundred for a serpent.

Q. What are the properties of the Greek language?

A. 1st\*, That it has a wonderful copiousness of words. 2d, That it is a language which abounds in compounds and derivations. 3d, That it enlarges and ennobles the human mind, by laying

\* The Greek and Latin alphabets are purposely omitted, as they are in the hands of every school-boy.

open

open the writings of the Greek philosophers, poets, and historians.

Q. What languages have had their rise from the Latin ?

A. The Latin can boast a noble progeny, for she gave birth to the Italian, French, Spanish, Portuguese, and a good part of the English.

Q. Which are the daughters of the old Gothic tongue ?

A. The two great branches, the Teutonic and Saxon languages ; from whence all the northern tongues, as so many grand-children, had their being ; as the Swedish, Danish, Norwegian, high and low Dutch, Flemish, Scots, and English.

Q. Who invented that orderly arrangement of the letters which we call by the Greek name alphabet \* ?

A. Cadmus, king of Thebes, son of Agenor, king of Phenicia, in the year of the world 1620.

The Hebrews, struck with admiration at this art, have called it *Dikduk*, that is, subtle invention.

The Americans, when they first saw a person read from a book, believed that the paper spoke.

We are told that an Indian slave, being sent by his master with a basket of figs and a letter to a  
gentle-

\* From *Alpha*, *Beta*, the two first Greek letters.



gentleman, ate on the way part of the fruit, and delivered the rest with the letter. The gentleman having read the letter, and not finding the quantity of figs it mentioned, accused the slave of eating those missing, and read him the letter; but the poor Indian protesting his innocence, cursed the paper, and accused it of false evidence.

Some time afterwards he was again sent on the same commission, with a letter that expressly marked the number of figs he was to deliver. On the way he again ate a part as before, but with this precaution, that he might not be again accused, he first hid the letter under a large stone; most firmly believing, that if it did not see him eat the figs, it could not possibly be a witness against him. But the poor miserable wretch, accused more than ever, confessed the crime, and held in admiration the virtue of the paper.

## 2. *Grammar.*

Q. What is grammar\*?

A. Grammar is the art of rightly expressing our thoughts by words.

Q. How many sorts of words are there?

A. Nine;

\* From the Greek word *Gramma*, a letter.

*A.* Nine; 1<sup>st</sup>, the article (*a*); 2<sup>d</sup>, noun (*b*); 3<sup>d</sup>, pronoun (*c*); 4<sup>th</sup>, adjective (*d*); 5<sup>th</sup>, verb (*e*); 6<sup>th</sup>, adverb (*f*); 7<sup>th</sup>, preposition (*g*); 8<sup>th</sup>, conjunction (*h*); 9<sup>th</sup>, interjection (*i*). These are commonly called parts of speech.

(*a*) From the Latin word *articulus*, a joint or small part.

(*b*) From *nomen*, a name; it expresses the name of any person, place, or thing; as John, London, Goodness.

(*c*) From *pro*, for, and *nomen*, a noun, from its being used instead of a noun, to avoid the too frequent repetition of the same word.

(*d*) From *ad*, to, and *jacio*, to put; and signifies the quality of any person, place, or thing; as a *good* man, a *great* city, a *fine* horse.

(*e*) From *verbum*, a word; a verb being the principal word in a sentence.

(*f*) From *ad*, to, and *verbum*, a verb, and expresses the quality of a verb.

(*g*) From *præ*, before, and *pono*, to place, from its being set before nouns or pronouns.

(*h*) From *con*, with, and *jungo*, to join, is a part of speech that joins words or sentences together.

(*i*) From *inter*, between, and *jacio*, to throw, is a word that expresses any sudden motion of the mind.

2. What

Q. What are the rules of grammar ?

A. In living languages, as the English, French, Italian, &c. use is the best rule ; in the dead languages, as the Latin, Greek, &c. the rules are fixed.

Q. Is the study of the grammar of one's own country necessary ?

A. Most certainly it is ; for a competent grammatical knowledge of our own language is the true foundation upon which all literature, properly so called, ought to be raised ;—ignorant of the principles of grammar, we should be entire strangers to the delicacies of the language of our own country, and unable to express ourselves on the most trifling occasions properly, correctly, or politely. What, for instance, is more common, than to hear ignorant people say, *I loves, I knows, I sees*, instead of I love, I know, I see ; and committing a thousand other grammatical errors ? Even our best poets sometimes fall into such blunders, as Mr. Prior evidently does in the following lines :

Once more at least look back, said I ;  
Thyself in that large glass descry :  
When thou art in good-humour drest,  
When gentle reason rules thy breast,  
The sun upon the calmest sea  
Appears not half so bright as *thee*—[instead of *thou*.]

Q. Is

*Q.* Is the study of grammar difficult ?

*A.* It. is so in Greek and Latin, and even in French and some other modern languages, which have a great number of irregular verbs. But in English it is very easy, and therefore soon may, and indeed ought to be learned, by every young person.

*Q.* What is punctuation ?

*A.* Punctuation is the art of marking in writing the several pauses or rests between sentences, and the parts of sentences, according to their proper quantity or proportion, as they are expressed in a just and accurate pronunciation.

*Q.* What marks are used for this purpose ?

<i>A.</i> The period	} Thus marked {	.
The colon		:
The semicolon		;
The comma		,
The interrogation		?
The exclamation		!
The parenthesis		( )

## LESSON VIII.

1. *Of Rhetoric and Oratory.*

Q. WHAT is rhetoric?

A. The art of expressing ourselves well, and ornamentally, on any subject; to please, to touch the passions, and to persuade, whether in speaking or writing.—A speech made according to the rules of this art, is called an *oration*, and the speaker an *orator*.

Q. What are the qualifications of a good *orator*?

A. It is necessary that he should have the following requisites.

I. *Invention*, by which he finds out such reasons and arguments as are adapted to persuade or gain belief.

II. *Disposition* or *order*, that he may know how to dispose or arrange his arguments in a proper order or method.

III. *Elocution*, which is a clear and neat manner of expression, and is embellished with tropes and figures.

IV. *Memory*,

IV. *Memory*, which is the power of the mind to retain the things he has learnt, till he shall be in want of them.

V. *Pronunciation*, which relates to the delivery of a discourse or oration in a distinct and agreeable manner; with a pleasing modulation of voice, and becoming gesture of the body:—of all the qualifications of a good orator, *this* is certainly the most useful.

Q. You have mentioned tropes and figures, pray explain them to me; and first a trope?

A. A *trope* is an elegant and beautiful turning of a word from its proper signification to another. As charity is *cold*—You read *Virgil*, i. e. his writings—The clouds drop *fatness*, &c.

Q. What are figures?

A. The figures of speech render it fine and beautiful: some regard the *meaning* of words; as, if we *ride*, let's ride, i. e. push on; some the *sound*, as, he is not a *friend*, but a *fiend*; some the *order*, as, *meats* are for the belly, not the belly for *meats*; some relate to sentences; as, they change their *soil*, not their *minds*, who plow the main.

Q. How many parts has an oration?

A. Five; 1<sup>st</sup>, the *exordium*, or beginning of the discourse; 2<sup>d</sup>, the *narration*, which consists in a recital of facts; it ought to be *true*, or at least *probable*,

*probable, perspicuous, and concise*; 3d, the *confirmation* or arrangement of the proofs in an order most likely to persuade; 4th, *confutation*; for when the orator has confirmed his own arguments, he naturally then proceeds to confute and disprove those of his adversary. The confutation ought to be lively. 5th, the *peroration*, or, as it is sometimes called, *epilogue*, is a recapitulation of the principal arguments. The peroration ought to excite the feeling of hatred or pity, according to the nature of the subject, in the minds of the persons to whom the oration is addressed.

Q. As it is so desirable a thing to be able to read and speak with propriety, give me, if you please, some practical and easy rules by which this accomplishment may be acquired?

A. The rules that appear to be best adapted to form a correct and graceful speaker, are,

I. Aim at nothing higher, till you can read distinctly and deliberately.

Learn to speak slow, all other graces  
Will follow in their proper places.

II. Let your pronunciation be bold and forcible.

III. Acquire a compass and variety in the height of your voice.

IV. Pronounce your words with propriety and elegance.

V. Pro-

V. Pronounce every word, consisting of more than one syllable, with its proper *accent*.

VI. In every sentence distinguish the more significant words by a natural, forcible, and varied emphasis.

VII. Acquire a just variety of pause and cadence.

VIII. Accompany the emotions and passions which your words express, by correspondent tones, looks, and gestures.

## 2. *Of Poetry.*

Q. What is poetry?

A. A speaking picture, which represents in verse the life and actions of a person.

Q. What is a poem?

A. A complete and finished piece of poetry.

Q. What sort of verses are chiefly used in our poetry?

A. Those of ten, eight, and seven syllables.

Q. Give me an example of each.

A. First of ten, which is the common measure of heroic and tragic poetry.

Think of thy Father, and his face behold!  
See him in me, as helpless and as old!

Tho'



Tho' not so wretched : there he yields to me,  
 The first of men in sov'reign misery.  
 Thus forc'd to kneel,—thus grov'ling to embrace  
 The scourge and ruin of my realm and race,  
 Suppliant my children's murderer to implore,  
 And kiss those hands yet reeking with their gore.

Second, of eight, which is the usual measure for short poems.

And may at last my weary age  
 Find out the peaceful hermitage,  
 The hairy gown, and mossy cell,  
 Where I may sit, and nightly spell  
 O'er ev'ry star the sky does shew,  
 And ev'ry herb that sips the dew.

Third, of seven, called Anacreontic, from Anacreon, a Greek poet, who wrote in verse of this measure.

Fairest piece of well-form'd earth,  
 Urge not thus your haughty birth.

Q. Which are the kinds of poetry most in use?

A. The kinds of poetry are various : the most considerable sorts are, 1<sup>st</sup>, *Pastoral*, which describes a shepherd's life, or that of rural nymphs and swains,

*fwains*. 2d, *Elegy*, is a mournful poem, or funeral song. 3d, *Lyric Poetry*, is generally used in the composition of songs and odes. 4th, *Pindaric ode* (so called from its inventor Pindar) is a sort of poetry which consists of loose and free numbers, and unequal measures. 5th, *Satire*, is a free, jocose, witty, and sharp poem, severely inveighing against vice and all corrupt manners and persons. 6th, *Comedy*, is an agreeable imitation of the actions, humours, and customs of common life. 7th, *Tragedy*, in which the calamities of illustrious men are represented and acted over again. 8th, *Epic or Heroic Poem*, is a poetical narration in blank verse of some illustrious and important actions of the hero celebrated in the poem; as the great exploits of Achilles in the Iliad of Homer. 9th, *Epigram*, is an inferior sort of poem, whose peculiar character is brevity, beauty, and a sharp turn of wit at the end.

As to the Acrostic, Rondeau, Echo, &c. they are such trifling pieces of art, that scarce any poet but in a merry vein, or on some jocose occasion, will ever use them.

## LESSON IX.

1. *The Mathematics.*

Q. WHAT is meant by the mathematics?

A. A science that contemplates whatever is capable of being numbered or measured. It ranks the first of all sciences, because it consists only in demonstrations.

Q. Of what use are the mathematics?

A. They open and extend our ideas, strengthen and improve our understandings, fix our attention, and, by giving us a just habit of reasoning, prepare us for all other kinds of studies and important employments of life.

2. *Arithmetic.*

Q. What is arithmetic?

A. The

*A.* The art of computing by numbers. Addition, subtraction, multiplication, and division, are its principal rules, all the others arising only from different applications of them.

*Q.* What does addition teach?

*A.* To add many sums together, to know their total value.

*Example.*

3  
more 4  
more 12

---

make 19

Which is the total value of those three numbers.

*Q.* What is subtraction?

*A.* A rule teaching us to take a less number from a greater, to know what remains.

*Example.*

From 58  
Take 49

---

Remain 9

Which is the number demanded.

D 2

*Q.* What

Q. What is the use of multiplication?

A. It teaches to increase the greater of two numbers given, as often as there are units in the less.

*Example.*

Multiply 15  
by 4

---

And they will produce - 60

Which is the third number required.

Q. What is the fourth rule of arithmetic?

A. Division.

Q. What does it teach?

A. To find how often one number is contained in another; or to divide any number into what parts you please.

*Example.*

Divide 28 by 4, the answer will be 7.

Q. What are the other rules of arithmetic?

A. Reduction, rule of three, practice, alligation, fellowship, extraction of roots, interest, &c. what relates to annuities, pensions, &c. with every thing concerning commerce, and merchants accounts.

Q. To

Q. To whom is this science necessary?

A. To every person. It forms the mind, and disposes it to reason justly on all other sciences. It teaches us to set our affairs in order. In a word, arithmetic is the soul of commerce, and the mother of all the sciences.

Q. At what age may a child begin to learn to number?

A. When he is advanced in writing, and at least nine or ten years old. It is to no purpose for them to begin younger, for they will make no progress, let the master's care be ever so great; because the older they are, the more they are able to reflect with judgment.

### 3. *Commerce.*

Q. What is commerce?

A. The art of exchanging one thing for another, or buying or selling merchandise, &c. with an intention to gain.

Q. Has commerce been a long time carried on?

A. It appears to be as ancient as the world. At first it consisted in nothing more than in the exchange of things necessary for life, as it is at present practised on the coasts of *Siberia, Norwegian*

*gian Lapland*, and *Russian Lapland*; amongst the different nations of *Africa* and *Asia*, and almost all of *America*.

Q. Was money, which we find of such infinite utility in commerce, in use at that time?

A. Not at all; it was in succeeding ages that it came into use.

Q. What nations have made themselves most famous by their commerce?

A. The Phœnicians, Egyptians, Carthaginians, Athenians, Rhodians, Romans, Gauls, and Flemings; at present the English, Dutch, Venetians, and Genoese, carry on the most extensive commerce.

#### 4. *Geometry.*

Q. What is geometry?

A. A science teaching the mensuration of quantity in all its extents, length, breadth, and thickness.

Q. What is the meaning of the word geometry?

A. It is derived from the Greek, and signifies the art of measuring the earth. It had its rise among the Egyptians, who were, in a manner, compelled to invent it to remedy the disorders occasioned in their lands by the annual overflowings of the river Nile, which defaced every boundary.

Q. How

Q. How is quantity distinguished ?

A. Into lines, superficies, and solids.

Q. What is a line ?

A. A line is formed by the motion of a point ; and therefore is one dimension only, i. e. length.

Q. How is a superficies generated ?

A. By the motion of a line, and so hath two dimensions, i. e. length and breadth.

Q. How is a solid produced ?

A. By the motion of a superficies, and hath three dimensions, length, breadth, and thickness.

Q. How is geometry divided ?

A. Into three principal parts.

1. *Altimetry*, which is applied to the measuring all heights, accessible or inaccessible.
2. *Planimetry*, which teaches the mensuration of surfaces in square measures, such as square miles, yards, feet, inches, &c.
3. *Stereometry*, which is the mensuration of all kinds of solid bodies in solid, or cubic measures, as cubic feet, cubic inches, &c. This also includes *gauging*, or the art of finding the contents of any cask or vessel, or the quantity of liquor contained in them; also timber measure, superficial and solid.



## LESSON X.

1. *Architecture.*

Q. WHAT is architecture?

A. The art of building or raising all kinds of edifices ; as houses, churches, palaces, &c.

Q. How is architecture distinguished?

A. Into three sorts ;—civil, military, and naval.

Q. In what consists civil architecture?

A. In external ornaments and internal conveniences.

Q. What are the orders of civil architecture?

A. They are generally reckoned five ; 1. The Tuscan ; 2. The Doric ; 3. The Ionic ; 4. The Corinthian ; and 5. The Composite. To these may be added the Gothic, which is an old method of building, still preserved in the construction of almost all cathedral churches. These orders take their names from the people who invented them.

Q. What are the qualifications necessary for a good architect?

A. He ought to understand drawing, geometry, optics, arithmetic, history, and fable.

Q. In

Q. In what consists military architecture, called fortification?

A. In constructing such works about a town, &c. as will enable a small number of men within, to withstand, for a considerable time, the assaults of a greater number without. A town fortified is called a *fortress*.

Q. What is naval architecture?

A. The art of constructing vessels, whether for the service of war or commerce.

## 2. *Painting.*

Q. What is painting?

A. An art, teaching us by drawing, and the application of colours, to represent all sorts of objects.

Q. What are the most esteemed paintings?

A. Those representing historical events.

Q. How many sorts of paintings are there?

A. Five; 1. In oil; 2. In fresco; 3. In water-colours; 4. On glass; and 5. In enamel; to which may be added, miniature and pastel. Painting in oil was unknown to the ancients. The art has received the greatest advantage from this discovery.

Q. What are the qualifications of an excellent painter?

A. He ought to understand drawing in its highest perfection. He ought to have some knowledge of anatomy and geometry. He ought to read a great deal, to have great judgment and patience: he ought to be sober, and fond of his art.

### 3. *Sculpture.*

Q. What is sculpture?

A. The art of carving, or hewing stone into images. Every thing that is engraved or worked in relievo makes a part of this art.

Its antiquity appears from many places of the holy scripture—from the idols of Laban that Rachel carried off, and from the golden calf set up by the Israelites in the desert.

### 4. *Optics.*

Q. What is optics?

A. Optics is the science of vision, whether natural, as performed in the eye, or artificial, as effected by instruments.

\*

Q. How

Q. How is vision produced ?

A. Vision, or the sense of sight, is in all cases produced by the action of the rays of light upon the expansion of the fine *optic nerve* in the eye, called the *retina*.

Q. Pray what do you call light ?

A. That quality of certain bodies, whereby they become visible to us, and render others so.

Q. Is not the sun the fountain of light ?

A. Yes ; but in what manner that great fiery mass is fed with continued fuel to keep up his force, is a question equally useless and impossible to be resolved ; whether comets travel from other systems with a provision of this nature, or whether the ethereal vapours come from all parts with their supply, is not worth enquiring after. HE that made the comet sweep through immeasurable tracts of space, could, with equal ease, give permanent light and fire to the sun.

Q. Though it appears a task beyond the reach of human abilities to calculate exactly how long a ray of light is upon its journey, in travelling from the sun to enlighten our hemisphere, yet has it not been attempted ?

A. Yes ; and found to be seven minutes and a half, though it is a distance of ninety-five millions of miles ; consequently light travels at the rate of two

hundred and eleven thousand miles in a single second, which is upwards of a million times swifter than a ball from the mouth of a cannon.

### 5. *Mechanics.*

Q. What is mechanics ?

A. That science which teaches the nature and laws of motion, the action and force of moving bodies ; and the construction and effects of all those machines and engines which go by the name of mechanic powers.

Q. What is motion ?

A. A continual and successive change of place.

Q. What is rest ?

A. The continuance of a body in the same place for any time.

Q. Pray explain what is meant by a mechanic power.

A. Any machine or engine by which a man can raise a greater weight, or overcome a greater resistance than he could do by his natural strength without it.

Q. How many mechanic powers are there ?

A. They are said to be six in number ; namely, the *lever*, by which we lift weights much greater

than our strength, unassisted, could overcome : the *axle* and *wheel*, by which we can lift them to greater heights : the *pulley* lifts them higher still : the *screw*, which, if it could move without friction, would give him greater force than any of the rest : the *wedge*, used in cleaving wood, &c. and the *inclined plane*, by which heavy bodies are rolled up with greater ease. And of these all the most compound engines now consist ; as clocks, watches, orreries, most sorts of water engines, with an infinite variety of others.

## LESSON XI.

*Of the Division of Time, or Chronology.*

“ A little chronology will be highly useful.” KNOX.

Q. WHAT is chronology ?

A. A science that teaches the method of measuring time, and distinguishing its parts.

Q. What is time ?

A. Time is the duration of things : its parts are centuries, years, months, weeks, days, hours, minutes, seconds, &c. and by these the larger and lesser intervals of time are estimated and measured.

Q. What is a century ?

A. A century is a course of a hundred years ; and estimated frequently at three ages, in succession of generation.

Q. What is a year ?

A. A space of twelve months, which is the time the sun takes in passing through the twelve signs of the zodiac.

Q. What is the zodiac ?

A. A circle, shewing the earth's annual, or yearly, path through the heavens. On this circle  
are

are marked the twelve signs, which are numbers of stars reduced by the fancy of men into the forms of animals, and may be described in order thus :

The *ram*, the *bull*, the *beav'nly twins*,  
 And next the *crab*, the *lion* shines,  
 The *virgin* and the *scales* :  
 The *scorpion*, *archer*, and *sea goat*,  
 The man that holds the *water pot*,  
 And *fish* with glittering tails.

Q. From what is said of the patriarchs having lived so many centuries, and some even so long as nine hundred years, may we not believe that the years were then shorter than at present ?

A. No ; for we learn from Moses that the year consisted then, as now, of twelve months. In his history of the deluge, he tells us, that after the rains, which began the seventeenth day of the second month, had fallen upon the earth for the space of forty days and nights, it was only in the seventh month that the ark, which floated upon the waters, rested upon the mountains of Armenia ; and, in the tenth, that land began to appear.

Q. What is a month ?

A. A month is just the time wherein the moon is going round the earth, which revolution she performs in twenty-seven days, seven hours, and forty-three minutes ; so that there are twelve  
 lunar



lunar months in a year, and about eleven days more, though, for conveniency, and greater regularity, they are made but twelve in our almanacks, by adding a greater number of days to each month than it really contains.

Q. How many weeks are there in a year ;

A. Fifty-two.

Q. How many days are there in a week ?

A. Always seven.

Q. How are they named ?

A. Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, and Saturday. To these days the Pagans gave the names of the sun, moon, and planets: to the first the name of the sun, to the second of the moon, to the third of Mars, to the fourth of Mercury, to the fifth of Jupiter, to the sixth of Venus, and to the seventh of Saturn.

Q. Do all nations reckon them in the same order ?

A. No; the Christians count from Sunday, in memory of the resurrection of our Saviour, the Jews from Saturday, the Mahometans from Friday.

Q. What is a day ?

A. A day is either artificial or natural. The natural day contains twenty-four hours ; the artificial, only the time from sun-rise to sun-set.

Q. How

Q. How is the natural day divided?

A. Into two parts, night and day, properly so called.

Q. Is there no other division of the natural day?

A. Yes; into morning, noon, evening, and midnight.

Q. When do we begin the day?

A. The English, French, Dutch, Germans, Spaniards, Portuguese, and Egyptians, begin the day at midnight; the ancient Greeks and Jews, with the modern Italians and Chinese, begin it at sun-setting; the ancient Babylonians, Persians, Syrians, with the modern Greeks, at sun-rising; and the Arabians, and modern astronomers, begin it at noon.

Q. What is an hour?

A. An hour is the 24th part of a natural day, as shewn by clocks and watches. It is divided into sixty equal parts, called minutes, and these again into sixty equal parts, called seconds.

Q. What is meant by the seasons of the year?

A. The changes and varieties which happen in nature by the yearly revolution of the earth round the sun.

Q. How many are there?

A. Four.

Q. How are they called?

A. Spring,

*A.* Spring, summer, autumn, and winter.

*Q.* How long does each season continue?

*A.* Three months.

*Q.* When does spring begin?

*A.* On the 21st of March.

*Q.* When does summer begin?

*A.* On the 21st of June.

*Q.* When does autumn begin?

*A.* On the 23d of September.

*Q.* When does winter begin?

*A.* On the 21st of December.

*Q.* When is the length of the day and night equal?

*A.* This happens twice every year, once on the 21st of March, and again on the 21st of September. Both these times are called the equinoxes.

*Q.* How do we call the light that appears before the rising and after the setting of the sun?

*A.* The light seen before the sun is called Aurora, and after he sets the twilight; which latter name frequently is applied to both.

*Q.* What do we call the dog days?

*A.* Those intensely hot days between the 19th of July and the 28th of August; the star called the great dog star, during that time, was observed to rise and set with the sun, and from thence the name was given.

*Q.* When

*Q.* When is the longest day?

*A.* On the 21st of June, at the beginning of summer, after which they begin gradually to decrease.

*Q.* When is the shortest day?

*A.* The 21st of December, at the beginning of winter, after which they begin gradually to increase.

*Q.* Is this change the same in every part of the earth?

*A.* No; it is more or less according as the country is situated farther from, or nearer to the ecliptic, or course of the sun. There are, for example, some countries where the length of the day and night is always exactly, or nearly the same; others where the night, during the summer season, is only an hour, others where the night continues always six months, and the day consequently as many. This variety in the length of the day and night is illustrated by the globe.

*Q.* What other name is given to the 21st of June?

*A.* The summer solstice, because then the sun stops short in his journey towards the north, and begins to return southward.

*Q.* And what other name to the 21st of December?

*A.* The

*A.* The winter solstice, because then the sun stops short in his course towards the south, and begins to return northward.

Q. What are the names of the twelve months in their order ?

*A.* January, February, March, April, May, June, July, August, September, October, November, December.

Q. How many days does each of these months contain ?

*A.* Seven have thirty-one days ; January, March, May, July, August, October, and December. Four have thirty days ; April, June, September, and November ; and one alone, February, has twenty-eight or twenty-nine.

According to these verses.

Thirty days hath September,  
April, June, and November ;  
February twenty-eight alone,  
All the rest have thirty-one ;  
But when leap-year comes, in that time  
Hath February twenty-nine.

Q. How did the Romans divide their month ?

*A.* Into calends, nones, and ides ; calling the first day of every month its calends.

Q. How many days are there in a year ?

*A.* Three hundred and sixty-five.

Q. Is

Q. Is this number always the same?

A. No; it changes every four years, and the fourth year, which is called Bissextile, or leap year, has always one day more.

Q. How comes this change?

A. Every year consists of 6 hours nearly over the 365 days. These 6 hours in four years amount to one whole day, which is then added at the end of February; on this account it is that this month has twenty-nine days once in four years.

Q. Did the Romans reckon their months like us?

A. No; they had first only ten, afterwards they added two, but they always began their year at March.

Q. Who were the two great reformers of the Calendar?

A. Julius Cæsar and Pope Gregory XIII.

Q. What is an olympiad?

A. A space of four years. The ancient Greeks reckoned in this manner, because they celebrated at the beginning of every fifth year their games, which were contests in all the manly exercises, such as wrestling, boxing, running, chariot races, &c. in a plain near the town of Olympias; for this reason they were called olympiads. They were first instituted by Hercules in honour of Jupiter, 774 years before Christ.

Q. What

Q. What is an epoch?

A. An epoch is a certain point of time from which historians begin to reckon; as the creation of the world, the building of Rome, the birth of Christ, the destruction of Jerusalem, &c. It also marks the time from one remarkable event to another. It is, for example, an epoch from the creation of the world to the deluge, &c.

Q. What is a lustrum?

A. A space of five years, used only by the Roman poets.

Q. What is a jubilee?

A. A public festivity.

Q. What is an indiction?

A. A revolution of fifteen years, used only by the Romans, for indicating the times of certain payments made by the subjects to the republic.— It was established by Constantine in the year 312.

*Note.* According to the æra by which we reckon, we date the time of every memorable transaction, as,

A. M. i. e. *Anno Mundi*, the year of the world.

A. D. i. e. *Anno Domini*, the year of our Lord.

Ab U. C. i. e. *ab Urbe condita*, from the building of the city of Rome, and so of the other epochs.

For example, we say,

Noah's flood happened

A. M. 1656

The

The Kings were expelled, and  
Confular government esta- } ab U. C. 244  
blished at Rome,

Charlemagne was crowned em- } A. D. 800  
peror of the west,



## LESSON XII.

*Cosmography, or the Universe.*

Q. WHAT is cosmography?

A. A description of the world?

Q. What do we understand by the world?

A. The heavens and the earth; in a word, the whole universe.

Q. How is cosmography divided?

A. Into two parts; astronomy and geography.

Q. What is the use of astronomy?

A. It gives us the knowledge of the heavenly bodies, and teaches us, from the regularity of their motions since their creation by God, that there is an infinite power who directs their courses according to the order he has established.

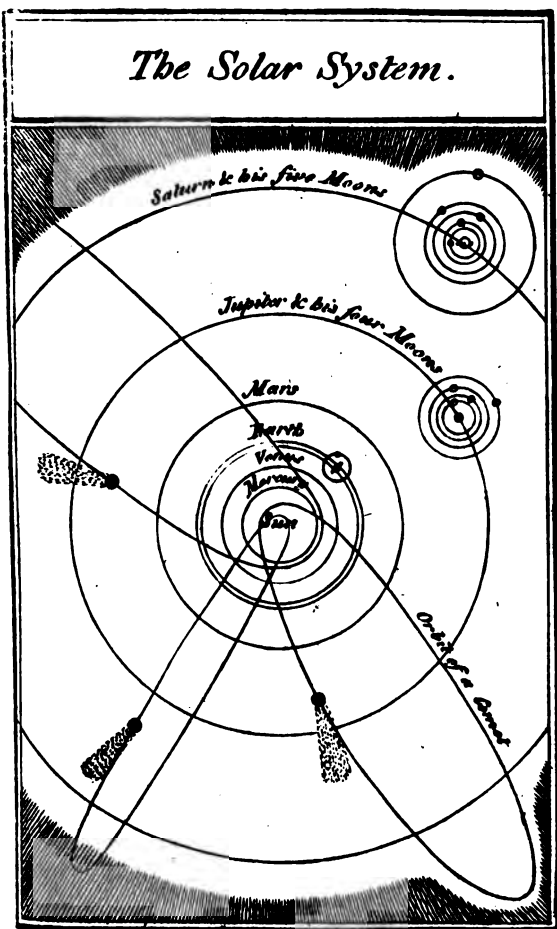
Q. How is this science most easily acquired?

A. As the figure of the world is round, we make use of two globes, one called the celestial, upon whose surface is painted the stars, reduced to constellations, with the circles of the sphere; and the other the terrestrial, which shews us upon its surface a description of the land and water.

Q. What do you call the heavens?

A. Those

# *The Solar System.*





*A.* Those regions or fields of air we see lying all around us above the atmosphere, in which are situated all the shining bodies, the sun, moon, planets, and stars.

*Q.* What is the atmosphere?

*A.* A thin fluid mass of matter which surrounds the earth. Its use is not only to suspend the clouds, furnish winds and rain, and serve for the common purposes of breathing; but it is also the cause of the morning and evening twilight, and all the glory and brightness of the firmament. It is extremely difficult to determine its exact height. Were it all as dense as on the surface of the earth, it would not exceed six miles. In general, however, it is supposed to be about twenty-seven or twenty-eight miles; and its greatest altitude cannot be more than forty-five or fifty miles: for the higher it goes, the thinner and lighter it becomes, and a smaller quantity of it occupies a larger space. We may justly say that the atmosphere serves as a shell or covering to the earth.

*Q.* What is the sun?

*A.* That glorious luminary created by God as the source of light and heat to the world.

*Q.* Is the nature of the sun known?

*A.* No; some imagine it to be a common fire, continually supplied with globules of combustible

E

matter

matter, and therefore have thought it to be the place of hell; others say that it is an elementary fire, which subsists without any kind of nourishment.

Q. Is the sun larger than the earth?

A. Yes; astronomers believe it to be more than a million of times as large. It appears so small as it does on account of its distance, which is so very great, that a cannon ball would be little less than thirty years coming from thence to the earth, even if it flew as swift as it does when it is first discharged from the mouth of the cannon.

Q. Does the sun move, or is he always fixed?

A. It was formerly supposed that he moved, because he seemed to do so.—But it is now demonstrated that he always remains fixed in the same place, and that it is the earth that moves round about him.

Q. Does the sun afford us any other benefit but that of light?

A. Yes; it ripens the fruits of the earth by its heat.

Q. Why is not the sun always visible after it rises?

A. A thick cloud will sometimes conceal it from our view, by interrupting its rays. Of this one may be easily convinced:—if we stand upon the  
top

top of a high mountain above the clouds, the sun will then be visible, but totally hid from those in the valley below.

Q. What is the moon?

A. A large globe like our earth in matter and form, designed to enlighten us by night.

Q. Is the moon a luminary like the sun?

A. No; it is a dark opaque body, and receives all the light she shines with from the sun, and by reflection conveys it to us in the sun's absence.

Q. How do we call the different degrees of light with which she shines?

A. Her phases. At NEW moon she is between the sun and the earth, and her enlightened parts are hid or turned from us; when FULL, we are between her and the sun, and we see all her enlightened side:—she likewise appears a horned, HALF, or gibbous moon, when a little part of her light turns towards us.

Q. What is the reason why some parts of the moon's face look dusky, and others light?

A. The bright parts of the moon's body are the highest parts of land, which reflect the light of the sun, as hills, mountains, promontories, islands, &c. and the darker parts of the moon are caverns, deep pits, and places which reflect not the sun's light so strongly as others.

Q. Is the moon larger than the earth?

A. No; the earth is at least fifty times bigger than the moon.

Q. What is its distance from the earth?

A. It is not exactly known, but supposed to be about two hundred and forty thousand miles.

Q. What influence has the moon?

A. She is said to be the cause of the tides.

Q. How happens that?

A. By attracting the waters of the sea, she raises them higher.

Q. What else is observable of the moon?

A. That she is inhabited: for to what end else can serve the distribution of land and water, mountains and vallies, but, as on our earth, to nourish and sustain men, beasts, and vegetables.

Q. How are the stars distinguished?

A. Into *fixed* stars, and *planets*, or moving stars.

Q. What are the fixed stars?

A. They are supposed to be so many suns, like ours, having planets, or habitable worlds, moving round them.

Q. What is their number?

A. They are supposed to be numberless. No more, however, can be seen at once by the naked eye, than about a thousand, nor have any more been discovered by the help of glasses than about 3000.

The

The reason of their appearing so much more numerous is owing to their strong sparkling, and our looking at them in a confused manner.

Q. What is a planet ?

A. A star that has a periodical and regular motion.

Q. How many planets are there ?

A. Seven ; their names are, reckoning them according to their nearness to the sun, 1st, Mercury ; 2d, Venus ; 3d, the Earth ; 4th, Mars ; 5th, Jupiter ; 6th, Saturn ; and 7th, the Georgium Sidus, a modern discovery of Dr. Herschell, in the year 1782. The earth has one moon to attend it, Jupiter four moons, Saturn seven, and the Georgium Sidus two moons.

Q. In what form or manner do these planets move ?

A. They all, in different stated periods of time, perform their motion round the sun from west to east, in orbits nearly circular.

Q. How may they be known ?

A. Mercury may sometimes, though not frequently, be seen by the naked eye, on account of his nearness to the sun, in the splendour of whose beams he is totally absorbed. The only way of observing him is in his passage over the sun, when he appears like a black spot on its surface. Venus



is sometimes our evening, and sometimes our morning star. Mars and Saturn may be easily known by their deep red colour. And Jupiter is distinguished from the fixed stars by the largeness of his size, and the brightness of his colour, which is so great, that it will sometimes illuminate a thin cloud in the same manner as the moon. The Georgium Sidus is not readily seen without a telescope.

Q. Have all the planets moons attendant upon them like our earth?

A. No; such only of the planets as are farthest from the sun, and therefore enjoy least of his light, have that deficiency made up by several moons, which constantly accompany and revolve about them, as our moon revolves about our earth. We have said that the Georgium Sidus, the farthest planet, has two moons, Saturn has five, and Jupiter has four; these were first discovered by the telescope, nor are they to be seen without it.—These moons are generally called satellites, or secondary planets.

Q. What is a comet?

A. A large solid body, with a long transparent tail, issuing from that side which is turned away from the sun, which moves in an orbit so extremely eccentric, as sometimes to disappear for many, perhaps

perhaps even for hundreds of years, and then appear again.

Q. How many comets belong to our system?

A. They are commonly thought to be 21.

Q. Of how many of these are the periods, or times of return, known?

A. Of three only.

Q. When do they return?

A. One of them returns in 75 years, another in 129 years, and the third, or most remarkable, in 575 years. It appeared in 1680. When nearest the sun, Sir Isaac Newton computed its heat to be 2000 times greater than that of red-hot iron; and that it must retain its heat till it came round again.

The comets must be made of matter much harder and denser than our earth, because, in their approaches to the sun, they sustain a degree of heat that would vitrify or dissipate any kinds of bodies that we know.

Q. Does the appearance of a comet foretel any great event?

A. No; it was formerly supposed it did, but it was mere superstition.

Q. What is the earth?

A. The earth is the globe we inhabit.

Q. How large is it?

E 4

A. Its

*A.* Its circumference is about twenty-five thousand miles.

*Q.* What is its true figure?

*A.* Though we often call it a globe, yet it is by no means perfectly round, but widened out at the equator, and flattened at both poles like a turnip; or if you are fonder of a hard name, its figure is an oblate spheroid.

*Q.* Is it always fixed, or does it move?

*A.* It moves constantly round the sun.

*Q.* How is this motion performed?

*A.* Two ways: the earth turns round its own axis every twenty-four hours, which alternately causes day and night, as either side is turned toward, or from the sun: it likewise revolves round that luminary in three hundred and sixty-five days, six hours, which periodical revolution produces the four seasons of the year. This double motion of the earth may be compared to a coach turning round in a court-yard—the wheels go round their own axis, at the same time that they move round the yard. It travels at the rate of fifty-eight thousand miles every hour, which is one hundred and twenty times swifter than a cannon-ball; and, by its rapid motion on its axis, the inhabitants of London are carried five hundred and eighty miles every hour.

hour. Those at the equator move much faster ; those towards the poles much slower ; and those at the very poles move hardly at all.

Q. What is an eclipse ?

A. An eclipse is nothing but a total or partial privation of the light of the sun or moon.

Q. How many sorts of eclipses are there ?

A. Two ; one of the sun, the other of the moon.

Q. When does an eclipse of the sun happen ?

A. When the moon comes between the sun and the earth. In this position she will wholly or partly intercept the rays of the sun, which is then said to undergo an eclipse. When this eclipse is total, the darkness is so great, that the stars will appear at noon-day.

Q. What is the cause of the eclipse of the moon ?

A. The coming of the earth between the moon and the sun : it is easy to be conceived, that the moon, having no light of her own, when the rays of the sun are intercepted from her, she will appear dark or dusky.

An eclipse of the *sun* never happens but at a new moon, nor one of the *moon* but when she is full.

LESSON XIII.

*Of Geography.*

*Totam licet animis, tanquam oculis, lustrare terram mari-  
aque omnia.*

“ One may survey the whole earth, and all the seas that  
“ surround it, in the mind, just as they are presented to  
“ the eye.” CICERO.

Q. WHAT is geography?

A. A description of the earth.

Q. How is the earth divided?

A. Into four parts: 1st, Europe, we inhabit;  
2d, Asia; 3d, Africa; 4th, America.

Q. By whom was the earth peopled?

A. By the children of Noah—*Shem, Ham, and  
Japhet.*

Q. Why is America often called the new world?

A. Because it was not discovered till about the  
end of the fifteenth century, about three hundred  
years ago. It was discovered in 1492.



Agreeable to the last Discoveries in the South Seas &c.



**Q.** By whom was it discovered?

**A.** By Christopher Columbus, sent by Ferdinand King of Spain.

**Q.** Why then is it called America?

**A.** Because one named *Americus Vespucius*, being sent after Columbus, discovered a greater part of the continent. It is named also the West Indies, to distinguish it from the East Indies in Asia.

That term, however, is more properly applied to the islands on the coast of America, than to America itself. The reason of their being so called was this:—When Columbus, who was in quest of a west passage to the Indies, arrived at the first land, which was the island of Hispaniola, he really thought he had reached the Indies, and therefore gave it that name. But upon his error being discovered, the term *West* was added to Indies, in order to distinguish them from the real Indies, which lye in Asia, and are so called, either from the Indus, one of the principal rivers of the country, or from the word Hindoos, the name of the original inhabitants.

**Q.** Which is the largest of the four parts into which the world is divided?

**A.** America.

**Q.** Which has most mines of gold and silver?

**A.** The same.



Q. Which of them is the richest in natural productions?

A. Asia. It is this quarter that furnishes our spices.

Q. And where is the heat of the sun most intense?

A. In Africa, which produces negroes, a race of people quite black, having flat noses, thick lips, and hair like wool.

Q. And which is that most peopled, and where the sciences are most cultivated?

A. Europe, though the smallest of the four.

Q. How are the four parts of the world distinguished?

A. From the time of Charles the Great they have been distinguished by the names of east, west, north, and south.

Q. How do we know where to find those parts?

A. Only by turning the back to the sun at noon; and on the right will be the east, on the left the west, behind us the south, and directly opposite will be the north.

Q. How are the winds that blow from these four quarters named?

A. They are called after the same manner; 1st, the East-wind; 2d, West-wind; 3d, North-wind; and 4th, South-wind.

Q. What

**Q** What is a sea?

**A.** A sea is a large collection of salt water.

**Q.** Whence is it that the sea water is charged with saltness, while that of rivers is mild, fresh, sweet, and fit for human purposes?

**A.** Some think it arises from great beds of salt lying at the bottom of the sea. But others more rationally suppose it is owing to the following cause: Salt is one of the original principles of nature, and is mixed, in greater or less quantities, with most other bodies. Now all rivers run into the sea, and carry some salt with them; but no rivers run out of it, nor is any water taken from it, but either by exhalation or evaporation. But chemists have demonstrably proved, that no salt can ascend in either of these ways; and consequently that all the salt that is carried into the sea by the immense numbers of rivers that run into it, remains behind, and occasions its saltness. That no salt ascends from the sea either by exhalation or evaporation, is evident from this, that rain-water, which falls from the clouds, and was originally extracted from the sea, is, of all kinds of water, the sweetest, purest, and lightest, and is made the standard by which philosophers judge of all other waters.

**Q.** How are the seas distinguished?

**A.** They

*A.* They are generally distinguished by their situation. Thus we say the South Sea, the North Sea, the British Sea, and the Irish Sea, &c. The general term for a large extensive sea, is an **ocean**; as the Atlantic Ocean between Europe and America, the Pacific Ocean between America and Asia, and the Indian Ocean between Africa and the East Indies.

*Q.* What is a strait?

*A.* A narrow passage of water, inclosed by two shores, as the Straits of Dover, between England and France, &c.

*Q.* What is a continent?

*A.* A large quantity of land, containing whole countries and kingdoms, and that is not surrounded by the sea; such as Europe, Asia, Africa, and America.

*Q.* What is a gulph?

*A.* A gulph is a part of the sea that runs in between land; if it be very large, it is rather called an inland sea.

*Q.* What is an isthmus?

*A.* A narrow neck of land between two seas, joining a peninsula to the continent: as the Isthmus of Darien, or Panama, which joins North to South America.

*Q.* What is a promontory?

*A.* A

*A.* A promontory is a high land that juts into the sea : it is often called a cape, as the Cape of Good Hope in the south of Africa.

*Q.* What is an island ?

*A.* An island is a part of the earth that is surrounded by the sea or other water, as Great Britain, Ireland, Sicily, &c. there are also islands in rivers.

*Q.* What is a peninsula, or almost an island ?

*A.* A part of land that is almost surrounded by the sea ; as the *Morea*, which joins to Greece.

*Q.* What is a lake ?

*A.* A lake is a large extent of water, inclosed all round with land, that never dries, and that has no current, as the Caspian Lake in Asia, most commonly, but improperly called the Caspian Sea.

*Q.* From whence do rivers and brooks derive their stores ?

*A.* A river is a stream of fresh water, formed from many springs, which, running down by the vallies between the ridges of the hills, and coming to unite, form little rivulets or brooks ; many of these again meeting in one common valley, and arriving at the plain, become a river, the magnitude of which is generally in proportion to the greatness of the mountain from whence its waters descend.

*Q.* What

Q. What are fountains or springs?

A. Fountains, or springs, are those waters that issue from the sides of hills and mountains, where they form natural pools or basins, which overflowing, the waters descend in rivulets, and, as before observed, give rise to rivers.

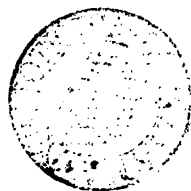
Q. What is a pond?

A. A quantity of water flowing from a river, or some other source, and confined by a bank for the preservation of fish.

Q. What is a marsh?

A. A very shallow, but stagnant water, that is often dried by the heat of the sun.







## LESSON XIV.

*Sequel of Geography.*

Q. HOW is the whole extent of the land divided?

A. Into an infinite number of countries or sovereignties.

Q. How many sorts of governments are there in Europe?

A. Seven; empires, kingdoms, the ecclesiastical state, republics, electorates, dukedoms, and principalities.

Q. How many empires are there?

A. Three; the empire of Germany, the Ottoman, or Turkish empire, and the empire of Russia.

Q. How was the empire of Germany formerly called?

A. The Roman empire.

Q. Why so?

A. Because its head is a successor of the ancient Roman emperors in the western empire.

Q. Is



**Q.** Is this empire as considerable now as formerly ?

**A.** No ; it has been extremely weakened by the many provinces that have been detached from it, and are become sovereignties themselves.

**Q.** What is remarkable of the Ottoman empire ?

**A.** That the greatest part of it is situated in Asia, and its head is a successor of the ancient Roman emperors in the east.

**Q.** Why is this distinction made between the eastern and western empires ?

**A.** For this reason ; when the Romans had conquered almost the whole earth, and formed the fourth monarchy, one of their emperors, Theodosius the great, ordered, that after his death, the empire should be parted between his two sons, Arcadius and Honorius. The first had the eastern part of the empire, and continued his residence at Constantinople. The second had the western part. This event happened about the end of the fourth century.

**Q.** What have you to remark of the empire of Russia ?

**A.** It is scarce seventy years since this country was erected into an empire, viz. in 1727 ; since that time its princes have been successively acknowledged emperors by the other European monarchs.

**Q.** What

Q. What title had these princes before ?

A. They had, and still keep, the name of *Tzar*, or '*Czar*', which signifies Great Duke, or King.

Q. How many kingdoms are there in Europe ?

A. Twelve ; Portugal, Spain, England, the two Sicilies, Sardinia, Sweden, Denmark, Poland, Prussia, Hungary, Bohemia, and France, if it be allowable to call that a kingdom, when its King has been executed, its Princes and Nobles exterminated, and its government declared Revolutionary by the representatives of the people ; but as this term is vague, and the convulsed state of the country renders it impossible to guess into what form of government it may settle at last, it may perhaps at present be best to continue the name by which it has been distinguished for near thirteen centuries.

Q. What is the ecclesiastical state ?

A. A part of Italy under the dominion of the Pope.

Q. How many republics are there ?

A. *Seven* ; 1st, Holland ; 2, Venice ; 3d, Genoa ; 4th, Lucca ; 5th, Ragusa ; 6th, Switzerland ; and 7th, Geneva.

Q. Are *they* also independent states like monarchies ?

A. Yes ;

*A.* Yes ; except Ragusa, which is under the protection of the Turks, and pays tribute to them.

Q. How many electorates are there ?

*A.* Nine ; three ecclesiastical, the Archbishop of Mentz, the Archbishop of Trèves, and the Archbishop of Cologne ;—six secular, the King of Bohemia, the Dukes of Bavaria and Saxony, the Prince Palatine, the Marquis of Brandenburg, now King of Prussia, and the Elector of Hanover, King of Great Britain.

Q. Where are they situated ?

*A.* All in Germany, except the electorate of Bohemia, which is an independent kingdom ?

Q. Are they all sovereign states ?

*A.* Yes ; but held by fief of the emperor and empire.

Q. How many dukedoms are there ?

*A.* They are too numerous to be reckoned up here.

Q. How are they divided ?

*A.* Into arch-dukedoms, grand-dukedoms, and dukedoms, properly so called ;—Austria is the only arch-dukedom ;—the grand-dukedoms are, Lithuania, united to Poland, and Florence to Tuscany in Italy.—The principal dukedoms are Lorraine, Courland, Silesia, Milan, Savoy, Parma, Modena,

Modena, &c. and in Germany, those of Saxony, Mecklenburg, Holstein, Wirtemberg, &c.

*Q.* What is a principality?

*A.* A principality, like a dukedom, is a small sovereignty.—There are a great many of them, and they are generally dependent on some more considerable state. In Germany there are two sorts, one ecclesiastical, the other secular; the former are arch-bishops, bishops, or abbots;—the latter are mar-graves, land-graves, or principalities, properly so called.

*Q.* What more is to be remarked of Germany?

*A.* Two things; 1st, that it is divided into circles; and 2d, that there are in it an infinite number of free and imperial towns.

*Q.* What is a circle?

*A.* A certain extent of country.

*Q.* How are they called?

*A.* 1st, Austria; 2d, Suabia; 3d, Bavaria; 4th, Franconia; 5th, Upper Saxony; 6th, Lower Saxony; 7th, Westphalia; 8th, Lower Rhine; 9th, Upper Rhine; and 10th, Burgundy, now united to France.

*Q.* What is a free and imperial town?

*A.* Free cities are little sovereign states, but have some dependence upon the emperor and empire.—The principal are Nuremberg, Augsbourg,

bourg, Ratifbonne, Hamburg, Franckfort, Cologne, &c.

Q. What are the capital cities of the three empires ?

A. The capital of Germany is *Vienna* ; of Turkey, *Constantinople* ; of Russia, *Petersburg*.

Q. What are the capital cities of the several kingdoms ?

A. The capital of the kingdom of Portugal is *Lisbon* ; of Spain, *Madrid* ; of England, *London* ; of the two Sicilies, *Naples* ; of Sardinia, *Cagliari* ; of Sweden, *Stockholm* ; of Denmark, *Copenhagen* ; of Poland, *Cracow* : of Prussia, *Koningzburg* ; of Hungary, *Buda* ; and of Bohemia, *Prague*.

Q. What is the capital town of the ecclesiastical state ?

A. *Rome*, which was formerly the capital of the Roman empire.

Q. What are the capital towns of the seven republics ?

A. *Amsterdam* is the capital of Holland, and *Zurich*, of Switzerland ; the others have the same name as the republics themselves.

Q. And the capitals of the electorates ?

A. *Mentz* is the capital of the electorate of the same name ; *Treves*, of the electorate of the same name ; *Bonn*, of Cologne ; *Prague*, of Bohemia ;  
*Munich*,

*Munich*, of Bavaria; *Dresden*, of Saxony; *Mannheim*, of the Palatinate; *Berlin*, of Brandenburg; and *Hanover*, of Hanover, or Brunswick-Lunenburg.

Q. What are the principal rivers in Europe?

A. The *Dwina* and the *Tanais* in Russia; the *Danube*, the *Rhine*, and the *Elbe*, in Germany; the *Seine*, the *Rhone*, and the *Garonne*, in France; the *Maese* in the Low Countries; the *Vistula* in Poland; the *Thames*, *Severn*, and *Humber*, in England; the *Tagus*, the *Ebro*, and the *Duro*, in Spain and Portugal; and the *Po* in Italy.

Q. What are the chief islands of Europe?

A. Great Britain and Ireland in the north; in the Mediterranean sea are Yvica, Majorca, and Minorca, subject to Spain. Corsica was formerly subject to Genoa, but declared itself a free state under the brave Paoli, who was afterwards driven out of his territories by the French, to whom the Genoese sold the island. Paoli retired to England, where he lived peaceably for some years; the French revolution, however, enabled him to return to his native country, where he was still considered as chief; and the Convention issuing some harsh decrees against the brave islanders, and ordering their beloved leader to be brought a prisoner to Paris, they resolved to throw off the yoke;  
with

with the aid of the English, most of the island has been recovered from the French, and the King of England has been declared King of Corsica in a full Assembly of the States. Sardinia is subject to its own King; and Sicily is governed by a viceroy under the King of Naples, to whom the island belongs. The islands of the Archipelago, with Candia, own the Grand Turk for their master; the islands of the Baltic, the Adriatic and Ionian Seas, are not worth your notice.

Q. How is *Asia* divided?

A. Into the kingdoms of Tartary, China, (from whence we have great quantities of china ware, raw silk, and tea) India, Persia, Indostan, and Turkey in Asia.

Q. What are the principal islands in this quarter?

A. The islands in Asia are the Marian, or Ladrone islands, Formosa and the Phillipines in the Eastern Ocean; the Moluccas, and the spice islands, Celebes, Borneo, Java, Sumatra, Ceylon, the Maldives, &c. in the Indian Ocean; Cyprus, Rhodes, Lesbos, or Mytilene, Chios, or Scio, Samos, Coos, and a few tohers of less note on the coasts of Asia and in the Mediterranean.

Q. What is this quarter most famous for?

A. Its having been the residence of our first parents, and giving birth to our blessed Saviour.

Q. What

**Q.** What are the manners of its inhabitants?

**A.** In general they are gross, ignorant, and lazy. They love only good cheer and their pleasures. They are extremely jealous of their wives, and cruel to their slaves.

**Q.** What are the chief kingdoms of Africa?

**A.** Egypt, Barbary, Morocco, Zaara, or the Great Desert, Negroland, Ethiopia, and Guinea, where ships go yearly to purchase slaves.

**Q.** Are the islands of Africa considerable?

**A.** Yes; but the following are the principal ones: Madagascar the largest, called also St. Lawrence, the inhabitants black, wild, savage, naked, and under no particular governor; the small islands of Cape Verd, the Canary islands, the Madeiras, noted for excellent wines, the Guinea isles, and the isles Ascension and St. Helena, with others of lesser note in the Ethiopic sea.

**Q.** What character have the people?

**A.** The inhabitants are for the most part tawny, and in some parts quite black; they have always been gross idolators, worshipping the stars, fire, and planets; they are accused of feeding on human flesh.

**Q.** What are the divisions of North America?

**A.** The chief kingdoms, states, and colonies in North America are, Old Mexico, or New Spain,

F

New



New Mexico, or Grenada, and Florida, belonging to Spain. New Scotland, New Britain, or Esquimaux, and Canada, to the English. New Hampshire, Massachusetts Bay, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, and Georgia, compose the United States; to which may now be added the infant States of Vermont and Kentucky.

Q. What are the islands of North America?

A. The islands belonging to Great Britain are Newfoundland, Jamaica, St. Christopher's, vulgarly called St. Kitt's, Antigua, Dominica, Barbadoes, the Grenades, Barbuda, Nevis and Montserrat, and St. Vincent's: except Newfoundland Jamaica, these islands are distinguished by the general name of the Caribbee Isles.

The islands belonging to Spain are Cuba, part of Hispaniola, or St. Domingo, the French part of which has been mostly taken by the English; Porto-Rico, the Virgin Isles, Trinidad, and Margareta — Martinique, Guadaloupe, St. Lucia, and Tobago, heretofore French, have been lately taken by the English.

Q. How is South America divided?

A. Into Terra Firma, Peru, belonging to the Spaniards, the country of the Amazons, but  
little

little known, the Brazils, belonging to the Portuguese, Chili, and Patagonia lately discovered.

*Q.* What else have you to remark of America ?

*A.* That its mountains are much higher, and its rivers much larger than those of the old world. The height of the Pyrenees between France and Spain is not seven thousand feet. The height of the mountain Gemmi (the highest point of the Alps in Switzerland) is but ten thousand feet. The height of the Pike of Teneriffe, in the Atlantic Ocean, is about thirteen thousand feet. But the height of Chimborazo, the most elevated point of the Andes, is above twenty thousand feet, that is, almost four miles.

*Q.* Are not the tops of these lofty mountains covered with perpetual snow ?

*A.* They are.

*Q.* To what is this owing ?

*A.* It is owing partly to their great height, and partly to the uncultivated nature of the country around them.

*Q.* How does their great height contribute to this ?

*A.* By placing them out of the reach of the reflected rays of the sun ; for it is well known, that the heat of a climate, or of the weather, depends

much more upon the reflected than the direct rays of the sun.

Of this any one may easily satisfy himself, by observing how much hotter he feels when walking on a sunshine-day in the paved streets of a town, than when walking in the country, or even when walking on a sandy road with a mud-wall on each side, than when walking on a plat of grass. In the two former cases the rays are strongly reflected; in the latter, they are either not reflected at all, or, at most, but very faintly.

Q. How does the uncultivated face of the country help to produce this effect?

A. By the very same means which we have now mentioned. An uncultivated country is so far from reflecting the rays of the sun, that it totally swallows them up by its woods, forests, and morasses.

And this probably is the reason why America is so much colder than Europe. In America it is as cold in 40 degrees of latitude, as it is in Europe in the latitude of 50, or even 55.

But in proportion as America comes to be cleared and cultivated, this difference will gradually decrease, till at last it is totally abolished.

Perhaps, however, it will never be totally abolished, as there seems to be a radical and an irremovable

movable cause for the superior coldness of America above that of Europe. We know from our whale-fisheries, that the northern parts of Europe are bounded by water; but it is yet a doubt among geographers, notwithstanding the discoveries of our circumnavigators, how far the land reaches towards the North Pole in America; and it is an acknowledged fact, that land is capable of imbibing and retaining a much greater degree of cold than water.

*Q.* How much broader are the rivers of America than those of Europe?

*A.* The largest rivers of Europe are not above a few miles in breadth. Some of the rivers in South America, and particularly the river La Plata, are 150 miles broad.

*Q.* Is not America as remarkable for its lakes as for its mountains and rivers?

*A.* Yes; the five great lakes at the head of the river St. Lawrence, are more like petty seas than lakes. Lake Superior, especially, is said to be 1500 miles in circumference.

*Q.* Which are the chief islands of South America?

*A.* Terro del Fuego, of which we have very little knowledge; Chiloe, near the coast of Chili, on which the Spaniards have a town named Castro;

tro; Juan Fernandez, off the coast of Chili, a pleasant fruitful island; the Gallipagos, a cluster of islands lying under the equator, off the coast of Peru.

Q. What is the general character of the natives of America?

A. They are, generally, of a brown complexion; the few that are white stain themselves of a red, or copper colour, and some with streaks of blue.— They are fond of adorning themselves with strings of beads and shells about their necks, and rings in their ears and noses;—they scalp their prisoners, and sometimes, it is said, broil and eat them.



## LESSON XV.

*Of History.*

Q. **W**HAT is history ?

A. History is an account or relation of any thing that has been done.

Q. How is history divided ?

A. Into sacred and profane, ancient and modern.

Q. What is sacred history ?

A. Sacred history is the history of the church of God, under the Old and New Testament. The Old Testament contains the history of the Jews, or Hebrews, or those who are called the people of God. The New Testament contains the history of Jesus Christ, the Son of God, and his disciples, who called themselves, after his name, Christians.

Q. What is profane history ?

A. Profane history is the account of the heathen gods, demi-gods, and heroes.

Q. What is ancient history ?

A. Ancient history is the account of all the em-

pires, kingdoms, republics, and states, from the creation of the world to the birth of Christ.

*Q.* What is modern history ?

*A.* An account of those empires, kingdoms, &c. from the birth of Christ to the present time.

*Q.* Have not the poets made another division of history ?

*A.* Yes ; they distinguished first the golden age, which they attributed to Saturn and Rhea, meaning by it the more perfect and happy state of men in the first ages of the world.

*2d,* The second is the silver age, ascribed to the reign of Jupiter, and which extended to the time that tyrants appeared among the human race, who, to render themselves powerful, oppressed mankind by violence and injustice.

*3d,* The third was the brazen age, which was, when rapacious men, possessed with the lust of dominion, endeavoured to reduce their brethren to a state of slavery.

*4th,* The fourth age is that of Iron, when all sorts of crimes began. They pretend it still continues.

*Q.* What is the earliest history we have ?

*A.* That of the creation of the world, the fall of man, the universal deluge, or flood, the preservation of the human race in the family of Noah,  
and

and the re-peopling the several nations by his three sons, and their posterity.

Q. How may we divide ancient history so as to have the clearest idea of it?

A. Into the four remarkable periods or æras of the four successive monarchies, called universal.

Q. Why were they called universal?

A. Because each of them extended over the greatest part of the then known world.

Q. What was the first of these universal monarchies?

A. The *Assyrian empire*, founded by Nimrod, the son of Cush, and grandson of Ham, in the year of the world 1800; was continued by his son Ninus, and after him by his wife Semiramis, the most celebrated heroine of ancient history, and ended under Sardanapalus in 3250, enduring 1450 years.

Q. What was the second monarchy?

A. The *Persian*. It began with their king, Cyrus, in the year of the world 3468, and ended with Darius's being conquered by Alexander the Great in 3670, before Christ 330, lasting a little more than 200 years.

Q. By whom was the third monarchy established?

A. The *Grecian*, which was the third universal monarchy, was established by Alexander the Great,



king of Macedonia, in the year of the world 3670, and lasted no longer than his life; for, at his death, as there was no proper successor left, his generals divided the empire amongst them.

Q. Why was Alexander called the Great?

A. Both on account of his natural valour, and also the success of his arms; for in twelve years he subdued all the nations from the Adriatic sea, to the river Ganges, in India.

Q. What was the fourth monarchy?

A. The *Roman empire*, founded by Romulus, at last arose, and became, under Augustus Cæsar, mistress of the whole earth, except China, and those countries that were either unknown, or inhabited by savage nations, or too inconsiderable to attract regard, and continued, under twelve Cæsars, to the year of Christ 96.

Q. Did not the Roman government undergo many changes?

A. Yes; the first state of Rome was regal, under twelve kings; the second was consular, under a series of consuls, for the space of four hundred and seventy years. After this the triumvirate was formed between Julius Cæsar, Pompey, and Crassus; but Cæsar aspiring to universal dominion and sovereignty, after a long war with Pompey, whom he defeated, gained to himself, not only the em-

pire of the Romans, but, in a few years, that of all the known world besides.

Q. How many forms of government are there ?

A. Three ; the monarchical, the aristocratical, and the democratical.

Q. What is the monarchical government ?

A. When the supreme authority is in the hands of one person. If he be a good prince, he is called a king ; if a bad and unjust one, he is called a tyrant.

Q. Have those persons who have the government in their own hands all the same degree of power ?

A. No ; some are despotic, that is, act as they please ; are absolute masters of the lives and fortunes of their subjects, and, in one word, have no other rule for their conduct but their will, while the authority of others is restrained by the laws.

Q. Who are these despotic sovereigns ?

A. The Emperor of the Turks, and in general all the princes of Asia and Africa. In Europe, the Empress of Russia and King of Denmark are despotic.

Q. What is the aristocratic government ?

A. When the sovereign authority is lodged in the hands of a few persons.

Q. In what countries is this kind of government established?

A. In the republics of the United Provinces, Venice, and Genoa.

Q. What is the democratical government?

A. When a number of persons deputed by a nation exercise the sovereign authority.

Q. What countries are under this form?

A. Many of the Swiss cantons, and several of the imperial towns.

Q. What is the best form of government?

A. This question is not yet decided; but this we may venture to say, that the monarchical government would be the best, were the monarchs always such as they ought to be.

Q. To what form of government do we generally give the preference?

A. To the republican?

Q. Why so?

A. Because it agrees best with our notions of liberty. It is, besides, the best adapted for improving all the powers and faculties of the human mind. The Greeks and Romans, who enjoyed a republican government, made such surprising advances in the arts and sciences, that they left all the other nations of antiquity infinitely behind them.

**them.** They are, indeed, the only ancient nations whose history is much worth the studying.

**Q.** What is the established government in England?

**A.** Limited monarchy, hereditary, and females are capable of succession. The title of his present Majesty is King of Great Britain, France, and Ireland, defender of the faith: and he is head of the church. His foreign titles are Duke of Brunswick-Lunenbourg, Arch-Treasurer and Elector of the holy Roman Empire. The heir apparent has the title of Prince of Wales by creation; he is born Prince of Scotland, Duke of Cornwall, and Earl of Chester.

**Q.** How was England anciently governed?

**A.** England was first under the *Britons*; 2dly, made tributary to the *Romans* by Julius Cæsar; 3dly, under the *Saxons*; 4thly, under the *Danes*; and 5thly, under the *Normans*, whose conquest of this island, by their bastard Duke, William, is the grand period from whence our historians begin to reckon.

**Q.** Name the succession of our English monarchs from the conquest, with the several families.

**A.** 1<sup>st</sup>, Four Norman kings.—1<sup>st</sup>, William Duke of Normandy; 2<sup>d</sup>, William Rufus; 3<sup>d</sup>, Henry I.; 4<sup>th</sup>, Stephen.

2dly,

*2dly*, Fourteen kings of the family of Plantagenet, who governed 331 years.—1st, Henry II. ; 2d, Richard I. ; 3d, John ; 4th, Henry III. ; 5th, Edward I. ; 6th, Edward II. ; 7th, Edward III. ; 8th, Richard II. ; 9th, Henry IV. ; 10th, Henry V. ; 11th, Henry VI. ; 12th, Edward IV. ; 13th, Edward V. ; 14th, Richard III.

*3dly*, Five sovereigns of the house of Tudor, who sat upon the throne 118 years.—1st, Henry VII. ; 2d, Henry VIII. ; 3d, Edward VI. ; 4th, Mary ; 5th, Elizabeth.

*4th*, Six monarchs of the house of Stuart.—1st, James I. ; 2d, Charles I. ; 3d, Charles II. ; 4th, James II. ; 5th, Mary II. Queen of William III. ; 6th, Anne.

*5th*, One king of the house of Nassau.—William III.

*6th*, Three kings of the Brunswick line, which acceded upon the death of Anne.—1st, George I. ; 2d, George II. ; 3d, George III.

Q. What families have succeeded to the crown of France ?

A. After the declension of the Roman empire, the Franks broke in upon the Gauls, and conquered the kingdom : their first king was *Pharamond*, A.D. 419 : of this family were twenty-one kings ; the second race began under *Pepin*, A. D.

751.—This line was followed by the Capetian race, so called from Hugh Capet, A. D. 988.—This family was succeeded by the house of *Valois*, in the person of Philip VI. A. D. 1328.—Upon the extinction of this family the succession fell on that of Bourbon, A. D. 1589.

*A.* What races of kings have succeeded to the Spanish crown?

*A.* Since the expulsion of the Romans, Spain has been governed by five families: the first from the Goths; the second, after the invasion of the Moors of Africa, from *Don Pelago*; the third from *Don Sancho*, king of Navarre; the fourth from the house of Austria, by the marriage of *Joanna*, daughter and heiress of Ferdinand, surnamed the *Catholic*, to Philip, arch-duke of Austria, eldest son of the emperor Maximilian; and the fifth from the house of Bourbon, in Philip, Duke of Anjou, second son of the Dauphin of France, and grandson to Lewis the XIV. whose descendants now wear the Spanish diadem.

2. Of what family is the Emperor of Germany?

*A.* Descended from Rodolph I. Count of Hapsburg and Landgrave of Alsace, who was the first of his family that obtained the Empire. He was elected, A. D. 1273.

2. Of what family is the Emperor of Turkey?

*A.* Of

*A.* Of the Ottoman family, so called from the warlike Sultan *Othman*, or *Osman*, who, A. D. 1300, carried his conquests to a prodigious extent.

Q. From what family are the kings of Portugal descended?

*A.* Portugal became a kingdom about the middle of the twelfth century. Count Henry receiving some territories bordering upon it from *Alonzo* King of Leon, as a marriage dowry with his daughter, he expelled the Saracens, and his son *Alonzo* conquered Lisbon, and assumed the title of King of Portugal in 1146.—In 1580 Philip II. of Spain seized upon this country; but in 1640, the Duke of Braganza recovered it, and in his family it has ever since remained independent of Spain.

Q. How is Holland governed?

*A.* By a stadtholder, or captain general, which office is hereditary in the Prince of Orange's family.

Q. How is the present government of Italy divided?

*A.* It is divided into little republics, principalities, and dukedoms, which, in spiritual matters, are subject to the Pope, who, like the ghost of the deceased Roman empire, sits crowned upon its grave.

Q. Who

Q. Who is the present Pope, and what is his character ?

A. Pius VI. John Angelo Braschi, born Dec. 27, 1717, elected Feb. 15, 1775, elegant in his person and manners, but of moderate abilities, and employs his time in all the little frivolous ceremonies and superstitions, which, as head of the Romish church, it is his office to perform, and to which he is extremely attached.

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*LESSON*



## LESSON XVI.

*Mythology.*

" Mythology is the basis of history, the standard of criticism,  
 " and the guide to the studies of youth."

BRYANT.

" *Ne ea quidem quæ sunt a clarioribus poetis ficta negligere.*"

" We must not overlook even the fictions of the more illustrious poets."

QUINTILIAN.

Q. WHAT is mythology?

A. The religion of the Pagans.\*

Q. In what did it consist?

A. In the worship of false gods, whom their poets, painters, and statuaries imagined, and to whom they gave different attributes.

Q. Who

\* Men of a phlegmatic disposition, or of a censorious temper, never cease to rail against the delightful fictions with which Homer and Hesiod, and their poetical imitators, have enriched and embellished their works: but although these

*Cybele*

*Mercury*



*Syrens*

*Juno*



Q. Who was the oldest of the gods?

A. Time, called also Saturn.

Q. What is said of him?

A. That he devoured his children as soon as they were born, because it was in the fates that one of them should usurp his dominions.

Q. Did

these fictions did not contain many useful instructions, and important truths, would there be any reason to attack and destroy a system which peoples and animates nature, and which makes a solemn temple of the vast universe? These flowers, whose varied and shining beauty you so much admire, are the tears of Aurora. It is the breath of Zephyrus which gently agitates the leaves. The soft murmurs of the waters are the sighs of the Naiades. A god impels the wind; a god pours out the rivers; grapes are the gift of Bacchus; Ceres presides over the harvest; orchards are the care of Pomona. Does a shepherd sound his reed on the summit of a mountain, it is Pan who, with his pastoral pipe, returns the amorous lay. When the sportsman's horn rouses the attentive ear, it is Diana, armed with her bow and quiver, and more nimble than the stag that she pursues, who takes the diversion of the chase. The sun is a god, who, riding on a car of fire, diffuses his light through the world; the stars are so many divinities, who measure with their golden beams the regular progress of fire: the moon presides over the silence of the night, and consoles the world for the absence of her brother. Neptune reigns in the sea, surrounded

Q. Did not any of his children escape?

A. Yes; Jupiter, Neptune, Pluto, Juno, and Ceres.

Q. By what means were they saved?

A. His wife, Rhea, pretended to be brought to bed, sometimes of a stone, at other times to have

surrounded by the Nereides, who dance to the joyous shells of the Tritons. In the highest heaven is seated Jupiter, the master and father of men and gods. Under his feet roll the thunders, forged by the Cyclops in the caverns of *Ætna*; his smile rejoices nature; and his nod shakes the foundation of Olympus. Surrounding the throne of their Sovereign, the other divinities quaff nectar from a cup presented them by the young and beautiful Hebe. In the middle of the great circle shines, with distinguished lustre, the unrivalled beauty of Venus, alone adorned with a splendid girdle, in which the graces and sports for ever play; and in her hand is a smiling boy, whose power is universally acknowledged by heaven and earth. Sweet illusions of the fancy! pleasing errors of the mind! what objects of pity, those cold and insensible hearts who have never felt your charms! And what objects of indignation those fierce and savage spirits, who would destroy a world that has so long been the treasury of the arts! a world imaginary indeed, but delightful, and whose ideal pleasures are so well fitted to compensate for the real troubles and miseries of the world in which we live.

miscarried,

miscarried, &c. &c. and concealed the infant she had been delivered of.

Q. What is meant by Saturn's devouring his children?

A. Only that time destroys all things.

Q. How was the sovereign authority divided between the three sons of Saturn?

A. Jupiter, as the eldest, had the heavens, Neptune the waters, and Pluto the infernal regions.

Q. Who is the messenger of the gods?

A. Mercury, son of Jupiter and Maia, god of eloquence, and patron of commerce: he had wings on his feet, and a caduceus, or wand, with two serpents about it, in his hand; and ushered souls into hell, or the Elysian fields.

Q. Who was Hebe?

A. The goddess of youth, daughter of Jupiter and Juno, and cup-bearer of Jupiter, because she poured out the nectar, the drink of the gods: their food was called ambrosia.

Q. Who is Cybele?

A. The wife of Saturn, called Rhea, and mother of all the gods. She was usually supposed to preside over the earth, and has therefore generally a crown of turrets on her head.

*Jupiter.*

*Jupiter.*

Q. Who was this god?

A. The pagans called him the father of gods and men; he was the son of Saturn and Rhea.

Q. Had he always the name of Jupiter?

A. No; his first name was Jovis, from which, by the addition of PATER, was formed *Jupiter*.

Q. How was he brought up?

A. The noise made by the musical instruments of the Corybantes, prevented his childish cries discovering him to his father Saturn, whilst he was nourished by the goat Amalthea.

Q. Where was he born?

A. Some say in Arcadia, others in the isle of Crete; some indeed give that honour to the city of *Thebes* in Bœotia, whilst others fix it at *Messenia* in Peloponnesus.

Q. What was his first action when grown up?

A. He deposed and banished his father Saturn, who had attempted to take away his life.

Q. What is recorded of Jupiter?

A. That he formed the world, which before was a chaos.

Q. Who was his wife?

A. Juno,

*Jupiter**Saturn**Pluto**Neptune*





*A.* Juno, his own sister.

*Q.* What is said of her?

*A.* The ancients considered her as goddess of kingdoms, queen of the gods and riches, daughter of Saturn and Rhea, sister and wife of Jupiter, who, by the continual jealousy between them, rendered themselves a very unhappy couple.

*Q.* Where was she born?

*A.* Some say at Argos, a town in Greece, others at Sainos.

*Q.* Did not Jupiter often transform himself to succeed in his amours?

*A.* Yes. He metamorphosed himself into a swan for Leda, daughter of Thestius, and wife of Tyndarus, king of Laconia;—into a bull, for Europa, daughter of Agenor, king of Phœnicia, and sister of Cadmus;—into a shower of gold for Danaë, daughter of Acrisius, king of Argos;—and into a shepherd for Mnemosyne, the goddess of memory.

*Q.* Did he always reign in peace?

*A.* No. His throne was shaken by the earth-born giants, called Titans, among whom was one, who, from an hundred hands at once, discharged an hundred mountains at the heavens. Jupiter, however, triumphed over them, and established his reign.

✱

*Q.* What

Q. What children had he by his different mistresses?

A. By *Leda* he had *Castor* and *Pollux*, brothers of *Helena* and *Clytemnestra*; they followed Jason in his expedition to Colchis for the golden fleece, and conceived so great a friendship for him, that they never left him: by *Europa*, he had *Minos*, and *Rhadamanthus*, who, from their severity in dispensing justice while on earth, were named judges of hell: by *Danæe*, he had *Perseus*, who rendered his name famous; he had also a friendship for men of letters, and founded a school: and by *Mnemosyne*, the goddess of memory, he had the *nine muses*.

### Neptune.

Q. What is related of this god?

A. That he had the sovereignty of the seas: he was the son of *Saturn* and *Rhea*, and brother of *Jupiter* and *Juno*.

Q. What became of him after his birth?

A. It is said that his mother concealed him, as soon as he was born, from the devouring jaws of Saturn; and substituted in his place a young foal, of which she pretended to have been brought to bed.

Q. Whom

Q. Whom did he marry?

A. *Amphitrite*, daughter of *Oceanus* and *Doris*, mother of the *Nereides*.

Q. What is the signification of the word *Neptune*?

A. It signifies in Greek *Mofele*, i. e. god of the waters.

Q. Who were his attendants?

A. The *Syrens*, the *Naiades*, and the *Tritons*.

Q. Who were the *Syrens*?

A. They were beings represented under the figure of a beautiful virgin, from the head to the middle, and from thence downwards by that of a fish, covered with scales. They are said to inhabit the steep rocks upon the sea shore, where, having allured passengers by the sweetness of their music, they put them to death.

Q. And the *Naiades*, who were they?

A. They were the same as the *Syrens*, half women, and half fish, and composed the train of *Amphitrite*. They resided, as so many domestics, in the palaces of the water gods; where they are said to work, and tell stories, and then to come and wait at table.

Q. What say you of the *Tritons*?

A. That they made the court of *Neptune*. Half of their body, from their head to the middle, re-

sembled a man, and the other half had the form of a fish.

Q. How are the *Tritons* represented?

A. As sitting upon a *dolphin*, with a wreathed trumpet in their mouth, with which they are supposed to convene all the water deities, when their monarch wanted their assistance or counsel,

Q. What are the attributes of *Neptune*?

A. He is represented sitting upon a pearl shell, drawn by two sea-horses, having a trident in his right-hand, used by him chiefly to agitate the waves; but he sometimes laid it aside when he was to appease them, though he resumed it on occasion.

Q. Where does he reside?

A. In a palace of crystal, at the bottom of the sea.

*Pluto.*

Q. Who was god of the infernal regions?

A. *Pluto*, son of *Saturn* and *Rhea*, to whom *Jupiter*, after destroying his father, gave the infernal regions as his part of the empire. This god was so extremely black and ugly, that he could not find any woman inclined to partake his throne, which

which determined him to carry away *Proserpine*, daughter of *Ceres*, whilst she amused herself with her nymphs in gathering flowers. He is represented upon a chariot drawn by four black horses.

Q. What are his attributes?

A. A sceptre, or battoon of two points, to distinguish it from Neptune's trident, which had three, and a crown of iron on his head.

Q. Who are the judges of the dead in the infernal regions?

A. *Minos*, *Æacus*, and *Rhadamanthus*.

Q. Who was the porter of hell?

A. It was guarded by a vast three-headed dog, called *Cerberus*, whose body was covered with snakes instead of hair. He was born of the giant *Typhon* and *Echidna*.—He is said to have given a kind reception to those unhappy souls who descended into hell, but devoured those who attempted to escape.

Q. What are the principal rivers in these dark realms?

A. 1. *Acheron*, whose waters are extremely bitter.  
 2. *Styx*, by which the gods were used to swear.  
 3. *Cocytus*, flowing out of *Styx*, with an horrible groaning noise, and encreases with the tears of the wicked. 4. *Phlegethon*, swelling with waves of fire. Over these four rivers, the souls were fer-

ried by Charon, to Tartarus, or Hades, the heathen hell.

2. Describe to me Tartarus.

A. TARTARUS, or the REGION of TORMENTS, is an hideous prison of a terrible depth, surrounded with the miry bogs of Cocytus, and the river Phlegethon, which rolls torrents of flames all around; three rows of walls, with brazen gates, render the place inaccessible. Here the wicked suffer a punishment proportioned to their crimes.\*

\* The most impious of the condemned in hell are the REBEL GIANTS, who, after their defeat by Jupiter, were cast down to Tartarus, to receive the punishment due to their enormous crimes. The poets, in speaking of these monsters, say, that they had snakes instead of legs. TANTALUS is represented as hanging over the waters, which are always flowing through his hand, and gliding from him: to this eternal torment of hunger and thirst he was condemned, for having invited the gods to a feast, when, to prove their divinity, he killed, boiled, and served up the joints of his son Pelops on the table before them to eat. SISYPHUS, a notorious robber, is condemned to roll a vast stone up to the top of a hill, which ever slides down again, and makes his labour perpetual. IXION, condemned for impiety and ingratitude, in attempting to violate the chastity of Juno, is fixed to a wheel, which hurries him round in one perpetual whirl.

2. Where

*Bellona.*



*Mars.*



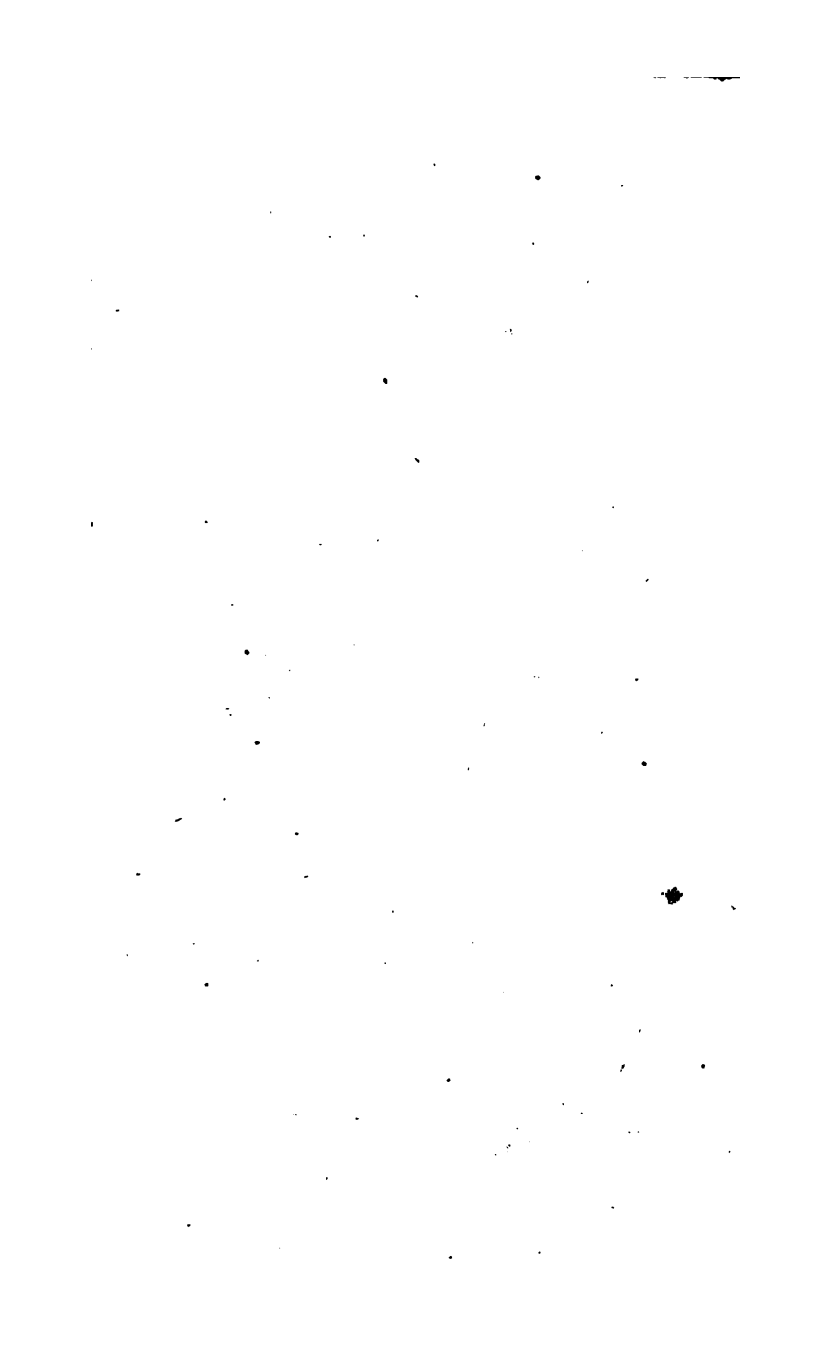
*Ceres.*



*Minerva.*

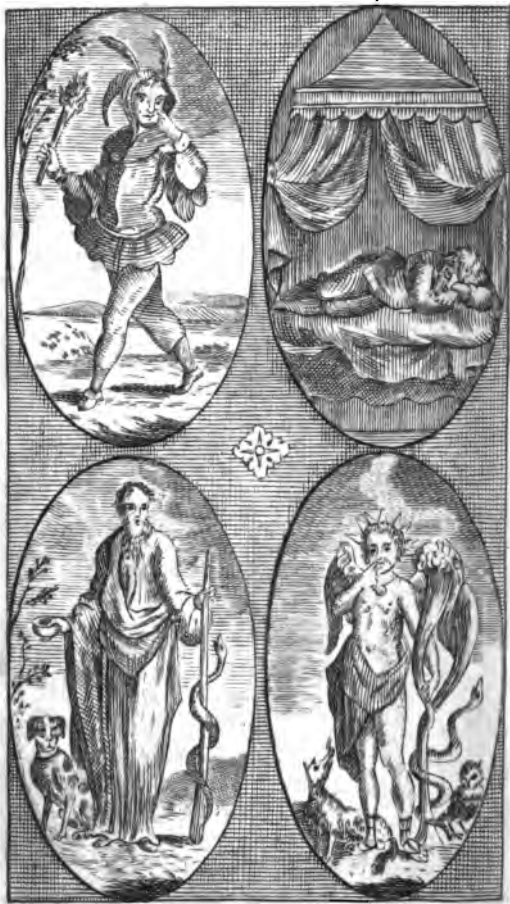






*Morvus.*

*Morpheus.*



*Esculapius.*

*Hesperus.*

Q. Where did they suppose the souls of the virtuous were conveyed after their death?

A. Into Paradise, which they call the ELYSIAN FIELDS, or the REGIONS OF BLISS. It consisted of pleasant plains, verdant fields, shady groves, purling streams, and a most serene and temperate air.—After the happy souls had long enjoyed this Elysium, they drank of the river Lethe, which made them forget all those pleasures, and then returned to the earth again, and possessed new bodies, in order to fill up the course of their probation in our world.

Q. What other deities do we meet with in the infernal regions?

A. Old *Erebus* and his wife *Nox*, who preside over darkness and night. Also *Mors* over death, and *Somnus* over sleep, who, by his servant *Morpheus*, sends dreams to us above while sleeping. The attendants upon *Somnus* are Rest, Ease, Indolence, Silence, and Oblivion.

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## LESSON XVII.

*Sequel of Mythology.*

“ A Knowledge of feigned History, or Mythology, is absolutely necessary to the Reader of the Classics,” &c.

KNOX.

Q. WHO is *Mars*?

A. *Mars* was the son of *Jupiter* and *Juno*; he was the god of armies and war, and is represented armed cap-a-pee, with a cock at his feet, because he metamorphosed into a cock his favourite *Alectryon*, who keeping watch whilst he was with *Venus*, suffered him to be surprised.

Q. Who was the goddess of war?

A. *Bellona*, sister to *Mars*, who generally conducts his car armed with a whip, and dishevelled hair.

Q. Who is the goddess of wisdom and the sciences?

A. *Minerva*, or *Pallas*. She is represented completely armed, with an owl at her feet, because

cause that bird sees in the dark, and intimates that true wisdom never sleeps.

Q. Who is the goddess of agriculture?

A. *Ceres*, daughter of *Saturn* and *Cybele*; who taught men the art of cultivating the land and sowing seeds; for which reason she has been honoured as the goddess of agriculture; she is painted as a beauty of the brunette kind, with ears of corn in her hands.

Q. Who is *Morpheus*?

A. The god of sleep.

Q. Who is *Momus*?

A. The god of folly. He is represented with a mask and grotesque face;—he was rather a jester, mocker, or mimic of the gods, than a god himself.

Q. Why was he thus represented?

A. Because he was always employed in examining the actions of gods and men, and reprehending them with freedom.

Q. Who is the god of silence?

A. *Harpocrates*, son of *Osiris* and *Isis*.—He is always painted with a finger on his mouth.

Q. Who is the inventor of medicine?

A. *Esculapius*, son of *Apollo*, and the nymph *Coronis*.—He is generally represented under the figure of a serpent.

Q. By whom was he brought up ?

A. By the centaur *Chiron*, from whom he learned physic.

Q. By whom was he killed ?

A. By Jupiter.

Q. For what reason ?

A. Because Pluto complained that his empire over the dead was much diminished by the art of Esculapius.

Q. Where was he adored ?

A. At Epidaurus, a town in Peloponnesus.

Q. What goddess presides over gardens and flowers ?

A. Flora ; and Pomona and her lover Vertumnus, over orchards and fruit-trees.

Q. Who are the principal rural deities, or gods of the woods ?

A. The Satyrs, and Fauns, who ranged over the country, but delighted chiefly in vineyards ; *Priapus*, an obscene deity, whose business was to drive away birds, and guard the fruit from thieves ; and *Aristæus* and *Terminus*, who was nothing but a bound stone : besides a great variety of nymphs ; as the Dryades, Arcades, &c. &c.

Q. Who was *Venus* ?

A. She was the handsomest of all the goddesses, who, soon after she was born, was carried by the Hours





Vulcan.

Venus.



Apollo.

Bacchus.

Hours with pomp into heaven, where the gods found her so extremely beautiful, that they were desirous of marrying her, and named her the goddess of love; her principal temples were at *Cythera*, an isle in the Archipelago, *Paphos*, a town of Cyprus, and *Amatontia*, another town in the same island.

Q. From what is she said to be produced?

A. From the froth of the sea.

Q. Had she any children?

A. Yes; she is the mother of *Cupid*, the god of love, whom they generally represent as a child of seven or eight years old, always naked, handsome, inclining to plumpness, and sometimes a little idle and sly. His quiver, bow, and darts, are continually mentioned to this day.

Q. Who are the attendants of *Venus*?

A. The three *graces*; their names are *Aglaia*, *Thalia*, and *Euphrosyne*. They are represented, generally, naked, like three beautiful sisters, and connected together.

Q. Whose wife was *Venus*?

A. She was the wife of *Vulcan*, god of blacksmiths, and son of *Jupiter* and *Juno*; as he was extremely ugly and deformed, as soon as he was born, *Jupiter* kicked him out of heaven. In the fall he broke his leg, of which he always remained lame. He is represented with a fiery red face

whilst at work with the Cyclops. This poor god is always the subject of pity or ridicule. He is the grand cuckold of heaven, and his lameness serves to divert the gods.

*Q.* What was the figure of the Cyclops?

*A.* They had vast bodies, were extremely ugly, and had only one eye, in the middle of their forehead.

*Q.* What is said of Vulcan?

*A.* That he was recalled to heaven, through the intercession of Bacchus, and re-established in the favour of Jupiter.

*Q.* With whom did he marry?

*A.* Jupiter caused him to marry Venus, whose infidelities to her husband have been strongly marked out from the earliest ages. The poets, in particular, have never spared her; and often speak of the public shame she was brought to by her amours with Mars.

*Q.* Who was Æolus?

*A.* The God of the wind, tempests, and hurricanes.—Aquila and Boreas are the cold winds of the north;—Eurus, or the genius of the east winds, presided over all the eastern quarter of the heavens;—Zephyrus, or the west wind, presided over the west, and is the mildest of all the wind deities;—and Auster, or Notus, the genius of the

South wind, was the chief director of the south. These wind deities were all brothers, sons of Astræus, the eldest brother of Saturn, by Aurora.

### *Of Parnassus.*

*Q.* What is Mount *Parnassus*?

*A.* The habitation of the nine *muses*, daughters of *Jupiter*, and the goddesses *Mnemosyne*, and where *Apollo* presides.

*Q.* Who is *Apollo*?

*A.* *Apollo* was the son of *Jupiter* and *Latona*. He is the god of poetry and music, and in that character is represented with a lyre in his hand, and a crown of laurels on his head. He is also god of the sun, and thence is generally called *Phæbus*.

*Q.* Where was he born?

*A.* At *Delos*, an island in the *Ægean* sea.

*Q.* What is the river that flows at the foot of Mount *Parnassus*?

*A.* *Hippocrene*, a fountain of Mount *Helicon*, in *Bæotia*.

*Q.* How is it said to have been formed?

*A.* The poetic horse, *Pegasus*, so often mentioned by the poets, gave a kick against the mount, and the river *Hippocrene* immediately sprung out.

Q. What are the names of the muses ?

A. *Calliope, Clio, Erato, Thalia, Melpomene, Terpsichore, Euterpe, Polyhymnia, Urania.*

Q. Over what particular science does each muse preside ?

A. *Calliope* is the goddess of heroic poetry ; *Clio*, of history ; *Erato*, of amorous poetry ; *Thalia*, of comedy ; *Melpomene*, of tragedy ; *Terpsichore*, of dance ; *Polyhymnia*, of the ode ; *Euterpe*, of music and musical instruments ; and *Urania*, of astronomy.

Q. How are they represented by the poets ?

A. As very young, very handsome, and adorned with garlands of flowers.

### *Of the Demi-Gods, or Heroes.*

Q. What do we understand by a hero ?

A. A title given by the Greeks to those who had made themselves famous.

Q. What is a demi-god ?

A. A man born of a god, or goddess, by a mortal : there are infinite numbers of them.

Q. Who are the principal ?

A. *Æneas, Ulysses, Hercules, Theseus, Achilles, and Jason.*

Q. What

**Q.** What is remarkable of the history of Æneas ?

**A.** He was a Trojan Prince, son of Anchises and the goddess Venus ; he is memorable for his great care of his aged father, whom he bore through the flames of Troy upon his shoulders, at the hazard of his life and his son's, a child, who was obliged to cling to his garments to escape them. Arriving in Italy, he married Lavinia, the daughter of Latinus, king of the Latins, and built Lavinium, so named after his wife. He died 1197 years before Christ.

**Q.** What is recorded of Ulysses ?

**A.** That on his return by sea from the Trojan war to the island of Ithaca, of which he was king, the Syrens used every effort to stop him ; but that he might not be surprised by their melodious voice, he stopped his ears, and caused himself to be tied to the mast of the ship.

**Q.** What are we told of his wife Penelope ?

**A.** Besieged by a numerous train of lovers in the absence of her husband, she delivered herself by artifice. She promised to make choice of one of them, as soon as a piece of tapestry, on which she was at work, should be finished ; but every night she unwove all she had done the preceding day.

**Q.** Who was Hercules ?

**A.** Son

*A.* Son of Jupiter and Alcmena, wife of Amphitryon. He was exposed through the whole course of his life to perform the most dangerous adventures, by the malignity of Juno, and the fatality of his birth. His principal exploits are termed, by way of eminence, the twelve labours of Hercules.

2. Explain them.

*A.* 1. Whilst a child in his cradle, he strangled two serpents which Juno had sent to destroy him.

2. He killed in the forest of Lerna, a frightful Hydra of fifty heads: when he cut off one of these heads, another immediately sprung up in its place.

3. He caught and killed on mount Menalus an extremely swift hind, with horns of gold.

4. He overcame Diomedes, king of Thrace, who fed his horses with the flesh of his guests, and threw him to be eaten by his own horses.

5. He took on the mountain Erimanthus, in Arcadia, a wild boar, that had made dreadful havock round the country, and dragged it alive to Euristheus.

6. He tamed a mad bull that laid desolate Crete.

7. He conquered upon the banks of Tarsesus, by the invincible force of his arm, a giant of immense

menſe ſtature with three bodies, and carried away his flock.

8. He ſeparated the mountains Calpe and Abila, which were before joined, and now form the Straits of Gibraltar.

9. He carried away the golden apples from the gardens of the Heſperides, after he had killed the dragon that watched them.

10. He ſuffocated, in wreſtling, the giant Antæus.

11. To eaſe Atlas he took the heavens upon his ſhoulders.

12. And laſtly he is repreſented covered with the ſkin of a lion of an amazing ſize, which he had conquered in the woods of Nemæa.

Q. How did the life of this famous hero end?

A. Having ſlain the centaur Neſſus, the dying monſter gave Dejanira (Hercules's wife) a garment dipt in his own blood, as a preſervative for love.—This Dejanira ſoon after ſent him to regain his affections. The hero had no ſooner put on the poiſoned ſhirt, than he was ſeized with violent and incurable pains; therefore making a funeral pile on mount Oëta, he ſet fire to it, and cloſed, with the moſt dreadful agonies, a life of hardſhips for the good of his fellow-creatures.

Q. What is meant by the Heſperides?

A. They



*A.* They were the daughters of Hesperius, son of Japet, and brother of Atlas.

*Q.* What is said of Atlas?

*A.* He was the son of Uranus, a great observer of the stars, and the first who represented the world by a sphere.

*Q.* What is related of Theseus?

*A.* He was the son of Ægeus, king of Athens, and Æthra, daughter of the wife Pitheus, at whose court he was brought up by Træzenus; he killed the Minotaur.

*Q.* What was this Minotaur?

*A.* It was a monster which had a bull's head, and all its lower parts human. It was inclosed in the Labyrinth at Crete, made by Dædalus, by the order of Minos, king of that isle, the inhabitants of which sacrificed men to Jupiter and Saturn; and where many of the gods and goddesses were born.

*Q.* Who was Perseus?

*A.* Son of Jupiter and Danaë, daughter of Acrisius, king of Argos. He was king of the Mycenians. He had the wings of Mercury, the shield of Minerva, the helmet of Pluto, and a sword forged by Vulcan. Thus armed, he overcame and cut off the head of Medusa. He also delivered Andromeda, daughter of Cepheus, king of Ethiopia,

opia, from a monster, and afterwards married her. He lived about 1348 years before Christ.

Q. What is said by the poets of the head of Medusa.

A. That it was surrounded by serpents instead of hair, and turned to stones those who had the rashness to look upon it.

Q. What is remarkable in the history of Achilles?

A. He was the son of the goddess Thetis, daughter of Nereus and Doris, the most beautiful of the Nereides; and Peleus, son of the famous Eacus, king of Egina, and the nymph Endeis, daughter of Chyron: he was educated by the centaur Chiron. His mother dipped him in the Styx, all but the heel, by which she held him, to make him invulnerable. He was slain at the siege of Troy by Paris, whose arrows shot him in the heel, 1180 years before Christ.

Q. What is a centaur?

A. A monster, half man and half horse.

Q. Who was Jason?

A. Son of Eson and Alcimede. Upon the death of his father, he was placed under the tuition of Pelias.

Q. What is his story.

A. At the persuasion of Pelias, he undertook  
the

the Argonautic expedition to Colchis for the golden fleece, which he carried away about 937 years before Christ.

Q. What golden fleece was that ?

A. The hide or fleece of a ram, called golden, because it was of a golden colour. It was guarded by bulls that breathed fire from their nostrils ; and by a vast and watchful dragon in the grove of Mars.

Q. Who was Pelias ?

A. Son of Neptune and Tyro.

Q. How was he brought up ?

A. He was fed by a mare and became the most cruel of all men.

Q. What did he when grown up ?

A. He not only usurped the estates of Jason, but caused him to be imprisoned.

Q. What else is recorded of him ?

A. He sacrificed his mother-in-law to Juno, and put to death the wife and children of Eson ; but Jason was saved from his fury, and educated in private.

Q. Who was Paris, and what was his judgment ?

A. Paris was the son of Priam, king of Troy, and Hecuba. At the wedding of Thetis and Peleus, when Juno, Venus, and Minerva were present,

sent, the goddess Discord threw into the assembly a golden apple, with this inscription, "To the fairest." Each of these three goddesses wanted to have the apple, and each said she was the fairest. At length they agreed to be judged by Paris, at that time feeding his flock upon mount Ida, who decided in favour of Venus. He is memorable in history for carrying off Helena, wife of Menelaus, king of Mycenæ, in his absence, which occasioned the famous siege of Troy, when he was slain by Pyrrhus 1188 years before Christ.

Q. Who was Pyrrhus?

A. Son of Achilles, king of Thessaly, and Deidamia, daughter of Lycomedes.

Q. What were the actions of this prince?

A. He was signalized for his cruelties.

Q. Mention some of them.

A. 1. He sacrificed Polyxena, daughter of Priam and Hecuba, upon the tomb of Achilles.

2. He massacred Priam at the foot of the altar.

3. He carried Andromache with Astyanax into Epirus.

Q. Who was Andromache?

A. Daughter of Ætion, king of Thebes, wife of Hector, and mother of Astyanax.

Q. What more did he?

A. Arrived in Epirus, he is said to have thrown  
Astyanax

Astyanax off a high tower, and to have married Andromache.

Q. How did he die?

A. Hermione his wife, daughter of Menelaus and Helena, prevailed upon Orestes, son of Agamemnon and Clytemnestra, with the promise of marriage, to assassinate him.

Q. Where did he accomplish this crime?

A. In the temple, at the celebration of a ceremony.

## A P P E N D I X.

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### NATURAL HISTORY.

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Q. **W**HAT do you mean by Natural History?

A. An account of the different productions of nature, whether they belong to the animal, the vegetable, or the mineral kingdom.

#### ANIMALS.

Q. What are the principal members of the animal kingdom?

A. Birds, beasts, and fishes.

#### B I R D S.

Q. Which are the principal or most remarkable birds?

A. The eagle, the ostrich, the swan, the cuckow, the nightingale, the humming-bird, the peacock, the vulture, the hawk, the kite, the owl, the parrot,

rof, the raven, the turkey, the pheasant, the lark, the goldfinch, the linnet, the canary-bird, the crane, the pelican, the cormorant, &c.

### THE EAGLE.



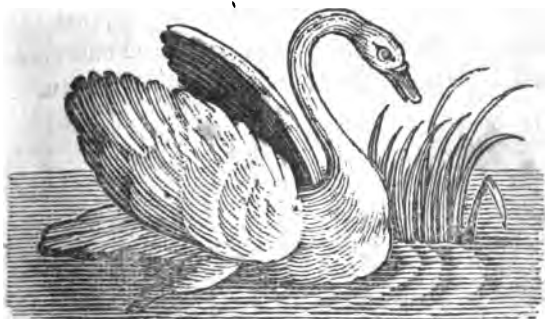
Q. What are the chief properties of the eagle?

A. There are many kinds of eagles; but that called the golden eagle is the largest, and is commonly called the king of birds. He is found in the deserts of Arabia, and the northern parts of Asia and Europe. He is a bird of great strength, exceeding bold, and very voracious and fierce in devouring his prey. He is of a great size, near four feet long from the point of the bill to the end of the tail; and between the points of each wing, when extended, near six feet: his beak is very strong;

stop, let down one of their wings, and covering their whole body with it, suffer the dog to get his mouth full of feathers; then taking to their heels again, ere the dog can disengage himself from the feathers, they are a considerable way before him.

What is most remarkable of this bird is, that it lays its eggs in the sand, and, entirely forgetting them, suffers them to be hatched by the heat of the sun, and, quite contrary to all other creatures whatever, appears utterly destitute of parental affection.

#### THE SWAN.



Q. What have you to say of the swan?

A. The swan is one of the principal of those amphibious web-footed birds that live either by

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land

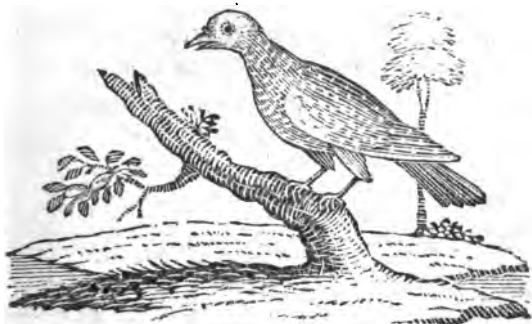


land or water. It is a large and stately bird, of a milk-white colour, and on a fine canal or river makes a beautiful appearance. Its neck is very long, and consists of between twenty and thirty joints, which enable it to fish as with a line.

In swimming, it is said to use one foot as an oar, and with the other to steer its body. They generally make their nests among the rushes, near the banks of rivers; and, during the time of the female's sitting, the male will attack any body that comes near her nest, with great fierceness and obstinacy.

The notion of this bird's melodious singing before its death is a vulgar error, and might probably take its rise from the fable of the ancients, that the soul of Orpheus, the old Greek poet and musician, passed by transmigration into the body of a swan.

## THE CUCKOW.



Q. What kind of a bird is the cuckow?

A. It is about the bigness of a magpie; its length, from the tip of the bill to the end of the tail, being above twelve inches. The throat, breast, and belly are white. The feathers of the head are of a dark brown, with white edges. The neck and back are brown, with a tincture of red; the rump is ash-coloured.

The cuckow herself builds no nest; but having found the nest of some little bird, she either devours or destroys the eggs she finds there, and in the room lays one of her own, and so forsakes it. The silly bird returning, sits on this egg, hatches it, and with a great deal of care and toil broods,

H 2

feeds,

feeds, and cherishes the young cuckow for her own, until it is grown up and ready to fly, and shift for itself. This seems a thing so strange and unnatural, that Dr. Willoughby, in his Ornithology, says he could not have believed it to be possible, unless he had seen it with his own eyes.

#### THE NIGHTINGALE.



Q. What have you to say of the nightingale?

A. Of all singing birds this is allowed to be the chief; his notes are sweeter, more melodious, and more various, than the notes of any other bird. And what is remarkable, is, his beginning to sing, or at least continuing to sing, after all the others have ceased, as if conscious to himself that his music deserved a more particular regard.

It

It is very rare that one can get a sight of these evening musicians; but the beauty of their feathers is not at all equal to the melody of their songs, their colours being a dusky reddish brown; and in size and shape they resemble the goldfinch. The time of their singing and breeding their young ones is from the latter end of April to the beginning of June, after which they are never either heard or seen till the same season returns again; insomuch, that many look upon them as birds of passage.

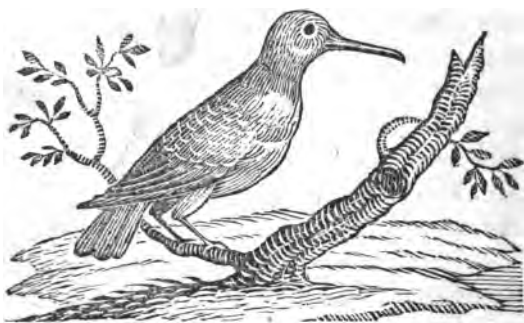
There is another kind of nightingale, called the Virginian nightingale, which is as big as a black-bird. It has a tuft on its head of a scarlet colour; with which colour also the neck, breast, and belly are adorned. The ends of the wings are not of so deep a red, neither is the tail. The colour of the whole is a lovely scarlet, only the head and tail more faint. Upon seeing its image in a glass, it has strange gesticulations, making a hissing noise, lowering its crest, setting up its tail like a peacock, shaking its wings, and, in a word, striking at the looking-glass with its bill.

Q. How many kinds of owls are there?

A. Not less than four; the common owl, the horn owl, the grey owl, and the fern owl.

The common barn owl is to be found in most parts of England.

## THE HUMMING-BIRD.



Q. Is not the humming-bird a very singular creature?

A. It is the smallest of all birds. The head, together with the feathers on it, is of the bigness of a middle-sized cherry; the neck is three quarters of an inch long; the body an inch and a quarter. The body, together with the feathers, is scarce equal in bigness to a Spanish olive. Its colour is wonderfully resplendent, so that it cannot be well represented by any painter; for with such a green as is seen in the necks of peacocks, a golden flame-colour, and a yellow, are curiously mixed; so that when it is exposed to the sun, it has a most shining appearance. It makes its nest in the boughs of  
trees,

trees, of the bigness of a Dutch shilling ; and lays very white eggs, two for the most part, of an oval figure, not bigger than pease. It is fed and nourished with honey-dew, and the juice of flowers, which it sucks out of them with its bill. It flies very swift, and makes a humming noise, like a hornet, or bee ; hence it has its name, in English, of humming-bird.

#### THE PEACOCK.



Q. What have you to observe with regard to the peacock ?

A. The peacock is a bird well known, and sufficiently distinguished by the length and glorious eye-like spots of his tail. His head, neck, and beginning of the breast, are of a deep blue. It

H 4

hath

hath a tuft on the top of its head, consisting of a kind of naked, but very tender green stalks, or shafts of feathers, bearing on their tops, as it were, lilly flowers, of the same colour. The neck is long, and, for the bigness of the fowl, very slender. The back is of a pale ash-colour, besprinkled with many black spots. The rump is of a deep green.

The long feathers of the tail are of a chesnut colour, beautified with most elegant gold lines, tending upwards, but ending in tips of a very deep green, and those forked, like swallows tails. The circular spots, or the eyes of the feathers, are party-coloured, of a deep green, shining like a chrysolite, a gold, or a sapphire colour : for those eyes consist of four circles of different colours ; the first golden, the second a chesnut, the third a green, and the fourth or inner place is taken up by a blue or sapphire-coloured spot, almost of the colour and bigness of a kidney-bean.

The hips, legs, and feet, are of an ash-colour, with black spots. The belly, near the stomach, is of a blueish green. Its food is the same with that of the common cock and hen.

## BEASTS.

## BEASTS.

Q. What are the most remarkable beasts?

A. The elephant, the beaver, the zebra, the lion, the panther, the leopard, the tyger, the rhinoceros, the porcupine, the camelion, the camelopard, the rein-deer, the crocodile, &c.

## THE ELEPHANT.



Q. What is the elephant?

A. The elephant is the largest of all land animals; and, if common report be true, it is at least equal to any in understanding and sagacity. Elephants are bred only in hot countries, such as the



East-Indies and Africa. They are frequently eleven or twelve feet high; and many of them much higher. Their make is very clumsy, and their strength prodigious. Their colour is generally a mouse-dun, or black; and the skin of their sides and back is so hard, that it is not easily pierced even by a sword or spear.

Their eyes are small, something resembling those of a sow, but very red. They have four teeth on each side, with which they grind their meat; and two large tusks, which hang out of their mouths, and grow to a prodigious size, frequently more than a hundred weight each. These they cast every tenth year, and by that means afford a very valuable commodity to the natives, who exchange these ivory teeth with the Europeans, for many other wares.

But the most remarkable part of the elephant is his proboscis or trunk. This is a large, hollow, gristly membrane, hanging down from the upper part of his nose towards the ground; and is so admirably contrived, so curiously wrought, and applied by the creature to its various occasions with such surprising facility and address, as plainly shews it to be the workmanship of an almighty creator.

Another thing remarkable in the elephant is, that the nipples of the female are placed near her breast.

breast. The reason of this is, that she is forced to suck her own dugs, and by the help of her trunk to convey the milk into the mouth of her young. The time of her going with young is one whole year, and the length of their life is generally thought to be upwards of a hundred. They live upon plants and roots, which they dig out of the earth with their tusks; or upon the fruit and branches of trees, which they pull down with their trunks.

They are, when tamed, extremely docile; and the various uses the ancient Indians and some other nations made of them in war, are astonishing. Many thousands of them have at once been led to battle, armed with various weapons, and taught to exercise their trunks with a mischievous dexterity. They were very useful also in throwing down trees, houses, walls, or whatever obstructed the march of an army.

Large wooden towers also were frequently fixed upon their backs, capable of containing 15 or 20 men armed with spears and javelins, which, from such an elevation, they darted at their enemies with great advantage. Yet it frequently happened, that these creatures occasioned as much confusion in the army to which they belonged, as

in that of their enemies; and for this reason the use of them in war has been long since laid aside.

Our own queen had a present made her of two elephants soon after her marriage; and she kept them (with a zebra) in her menagerie at Pimlico till they died.

#### THE BEAVER.



Q. I have heard a great deal of the beaver; pray, what kind of animal is it?

A. The beaver is about four feet in length, and its breadth twelve or fifteen inches. His fur, in the northern countries, is generally of a blackish colour; but, in the more temperate climates, it brightens into a reddish tincture. He is covered with two sorts of hair, one long and hardish, the other

other a soft down, which is manufactured into stuffs, hats, or stockings. They have a large, broad tail, which is covered with scales, almost like those of a fish.

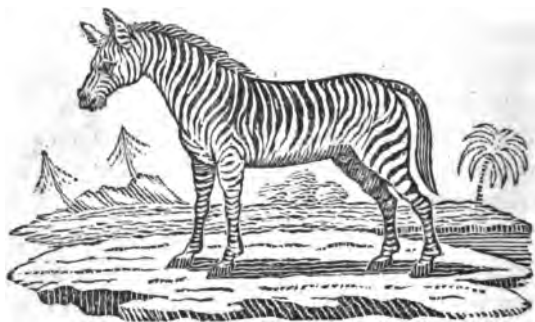
Both the male and female have two bags under their bellies, impregnated with a liquid substance, called by the physicians *Castoreum*, and, when prepared by the chemist, *Castor Drops*, or *Tincture of Castor*. It is prescribed as an excellent remedy against poisons, vapours, and many indispositions.

What is most remarkable in these creatures is, their great skill as architects. They build their apartments (or one may rather call them towns and cities; for they associate together in great numbers) with surprising art and dexterity. When they have found a convenient situation on the banks of a river, their next care is to seek out for proper timber to support the roofs of their subterraneous dwellings. For this purpose they pitch upon a tree, perhaps about as thick as a man's leg, which they gnaw with their teeth till they have cut it down.

Then they go to work upon the branches, and break them into pieces of one, two, or three feet long, according to the uses for which they intend them. And when these, which are the main joists and supporters, are disposed according to their mind,

mind, they then weave or wattle them with smaller twigs, and incrust over the whole with a plaister or cement, which serves either to keep out inundations, or to preserve the water in reservoirs for their own use ; against inundations they are generally provided with upper apartments, which they retire to when the floods arise, and descend from when the waters subside.

THE ZEBRA.



Q. As you mentioned the zebra, which the queen kept with her elephants, I should be glad to have some short account of that animal.

A. This, which is commonly called the wild ass, is an extremely beautiful creature ; and though  
in

in colouring it differs so much from all other kinds and varieties of the horse, it yet agrees with it in all other respects. It is about equal to the common ass in size, but of a much more elegant figure.

The head is small and short, the ears are long, the eyes are large and bright, and the mouth considerably large. The neck is long and slender, but elegantly turned; the body is rounded, and small in proportion to that of the common ass; the legs are long and slender, the tail long and beautiful, but hairy only at the end.

The whole animal is party-coloured, or beautifully striped, in a cross direction, with long and broad streaks; alternately of a deep, glossy, and shining brownish and whitish hue, and with some that are absolutely black. It is a native of many parts of the east.



## THE LION.



Q. What kind of animal is a lion?

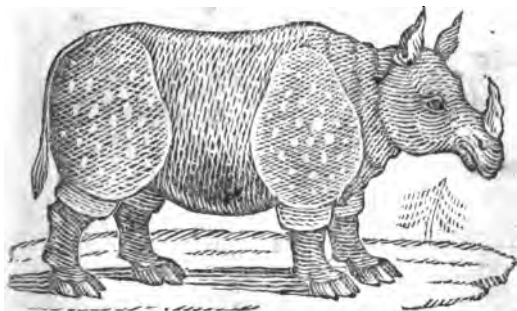
A. The lion, on account of his great strength and fierceness, is called the king of beasts, and is in general of a dun colour. The hair of some of them is curled; of others, long, shaggy, and thin. His head is very large and strong, his nose thick, his mouth very wide, and his eyes red, fiery, and hollow. His fore feet have five distinct claws on each foot, and the hinder but four; all crooked, sharp, and exceeding hard. His sight and smelling are very acute, and he sleeps with his eyes open. He cannot endure fire.

When

When other wild beasts hear his roaring, they are struck with terror, and dare not stir; though he himself is not without fear from some creatures, such, for instance, as the great dogs of India, with which, 'tis said, they hunt and kill him. He is commonly taken with nets and other snares.

The lioness differs from the lion in nothing but that she has no mane, which the other has. The panther, the leopard, and the tyger bear all a strong resemblance to the lion, only that they are curiously spotted.

#### THE RHINOCEROS.



Q. What is the rhinoceros?

A. The rhinoceros, so called because of the horn in his nose, is bred in India and Africa. His colour is



is like the bark of a box-tree. He is said to be in shape somewhat like a wild boar, and is not much unlike an elephant; being near as long, but not so high, having shorter legs. His skin is so hard, that no dart is able to pierce it, and is covered over with scales, like the shell of a tortoise. His legs are scaled over down to the hoofs, which are parted into four distinct claws.

The horn upon his nose, which bends backwards towards the crown of the head, is so very hard and sharp, that some say it will pierce through iron or stone. He is said frequently to whet his horn against a flint, that he may be prepared, whenever he is attacked by an enemy. He is a mortal foe to the elephant, whom he seldom meets without a battle; and aims chiefly at his belly, being the softest place, which if he misses, the elephant is too hard for him with his trunk and teeth. Naturalists say, that he grunts like a hog.



## THE CAMELOPARD.



Q. What have you to say of the camelopard?

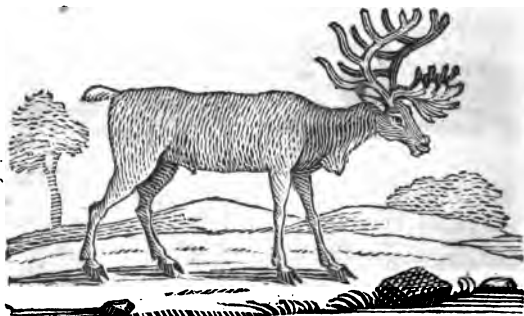
A. This creature is bred in Ethiopia, India, Georgia, &c. The head of it is like a camel's; its colour, for the most part, red and white, beautifully mixed together, and the skin full of spots. It has two little horns upon its head, of the colour of iron; has a small mouth, like a hart's; a tongue near three feet long, and a neck of divers colours, of a very great length, which it holds higher than a camel's, and is far above the proportion of its other parts.

His fore feet are much longer than the hinder. His pace is different from that of all other beasts;

for

for he moves both his right feet and both his left feet together. This creature is both like a camel and a panther. Its skin is very valuable. It is a solitary beast, and keeps in the woods, and is never taken but when caught young.

### THE REIN-DEER.



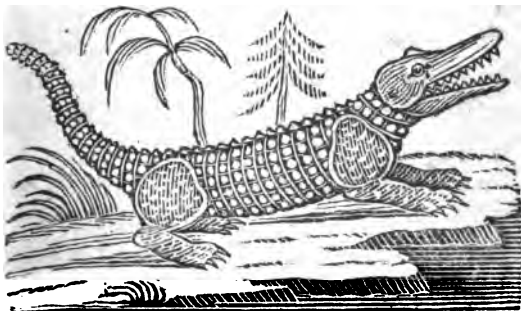
Q. What have you to observe of the reindeer?

A. This creature is chiefly found in Lapland. It is somewhat bigger than a stag. Its horns branch out into several small ones. Its feet are thick as a bull's. It is of an ash colour, but white on the belly and haunches. It resembles more an ass than a stag. Though it be cloven footed, it does not chew the cud. It is naturally wild; but, when tamed,

tamed, it answers many domestic purposes, such as drawing a sledge or cart, or carrying a burden.

In summer it feeds on grass and the leaves of trees; and, at other times, on a sort of white moss, which grows in Lapland. When the ground is covered with snow, it scrapes out this moss with its feet. It comes to its full growth at four years of age, and seldom lives above ten. With the milk of this creature they make cheese, but no butter. It runs over the snow with surprising rapidity, and equal steadiness.

#### THE CROCODILE.



**Q.** What have you to say of the crocodile?

**A.** The crocodile is a creature that lives both by land and water. It is of a saffron-colour, that  
is,

is, between a yellow and a red, but more inclining to yellow. The belly is somewhat whiter than the other parts. Its body is rough, being covered all over with a certain bark, or rind, so thick, firm, and strong, that it will not yield to a cart-wheel, even when the cart is loaded; and in all the upper parts, and the tail, it is impenetrable by any dart or spear; but the belly is softer, and there it is more easily wounded.

When it opens its mouth, it does not move its under jaw, like other animals; on the contrary, it moves the upper. Its tail is nearly as long as its whole body; and it is also rough, and armed with a hard skin upon the upper part and the sides; but beneath it is smooth and tender. It hath fins upon the tail, by means of which it swims, as it also does by the help of its feet, which are like a bear's, except that they are covered with scales instead of hair.

As its legs are short, it is very slow in its motions, so that it is no very difficult matter to escape it, especially if the person it pursues turns and winds out of the direct path; for the crocodile's body is so hard and stiff, that it cannot easily turn and wind after him.

It is common in the West-Indies, and still more upon the banks of the river Nile in Egypt, where

it is said to lie hid amongst the reeds and rushes, till it finds an opportunity to seize men or other animals, which it drags into the water, always taking this method of drowning them first, that it may afterwards swallow them without resistance. Its general food, however, is fish.

It is a wily cunning creature; and it is said, that when it sees a single man whom it is desirous of drawing into its clutches, it will weep and sigh, and make a most lamentable moan, as if it were in the utmost distress, till it has drawn him near enough for its purpose, when, suddenly springing upon him, it beats him down with its tail, and immediately destroys him. This is beautifully described by our old poet Spenser, in that passage where he compares the dangerous dissimulation and treacherous tears of Duessa (or Falshood) to the crocodile.

As when a weary traveller, that strays  
By muddy shore of broad seven-mantled Nile,  
Unweeting of the perilous wand'ring ways,  
Doth meet a cruel, crafty crocodile,  
Which, in false guise hiding his harmful guile,  
Doth weep full sore, and shedding tender tears;  
The foolish man, that pities all the while  
His mournful plight, is swallow'd up unawares,  
Forgetful of his own, that minds another's cares.

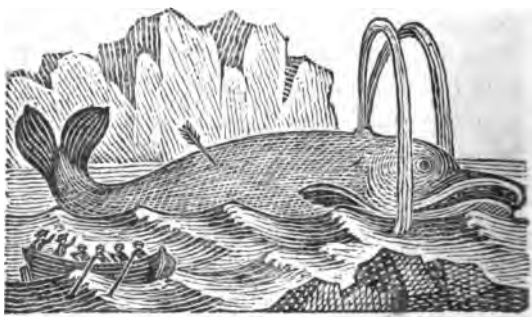
Hence it is, that hypocritical or affected grief and weeping is, by the common proverb, stiled *Crocodile's tears*.

## FISHES.

Q. What are the most remarkable fish?

A. The whale, the shark, the salmon, the tortoise, the turbot, the flounder, the haddock, the whiting, the herring, the mackrel, &c.

### THE WHALE.



Q. What are the chief properties of the whale?

A. The whale is the largest of all fish, and indeed of all living creatures, whether by sea or land ;  
for

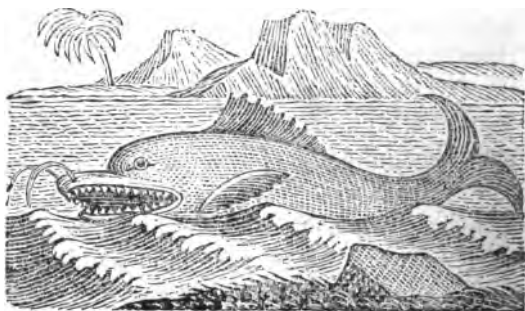
for what we have been told of the Craken, which, according to those who pretend to have seen it, resembles an island rather than an animal, and in whose body, it is said, the fishermen sometimes cast anchor, is looked upon by the most sensible persons as a mere fable.

The whale is in general from 150 to 200 feet long, and of a proportionable thickness. Its head is about one-third part of its whole length, on the top of which is what they call the hovel or bump; in which are two spout-holes, from whence, either in sport or when wounded, it throws the water with such force, that it roars like a hollow wind, or the sea in a storm, and may be heard at the distance of a league.

What we call whalebone is found in the mouth and throat of the animal, in most of them perhaps about 500 pieces, each 15 feet long. The whole produce of a whale is about a thousand pounds, sometimes more and sometimes less, according to the goodness of the fish.



## THE SHARK.



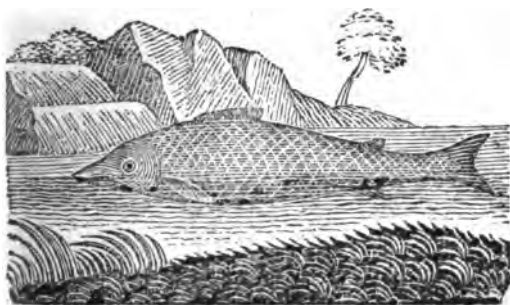
Q. What kind of fish is the shark ?

A. It is very large, and reckoned the boldest of all fish. Rondeletius says, that he saw a middling one, that weighed almost a thousand pounds. Gillius says, that he was credibly informed, that a fish of this sort, not weighing less than four thousand pounds, being dissected, had a whole man found in his belly. He further adds, that the people of Marseilles told him, that they had caught one, in which they found a man armed with a coat of mail.

The fish is common in the West Indies, and is very destructive to those that amuse themselves  
with

with swimming ; it sometimes biting a man asunder, and at other times taking off a limb at least ; yet it is often caught and eaten by the sailors.

#### THE SALMON.

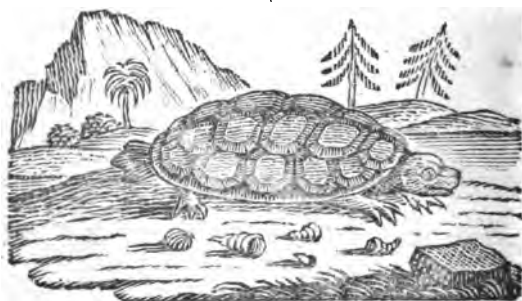


Q. What kind of fish is the salmon?

A. Of all river-fish the salmon is the chief, though whether it can be properly called a river-fish or not, is doubtful ; for they enter the fresh water about February or March, where they continue till autumn, when they return again to the sea. It is said by those who are acquainted with these fish, that the salt water best promotes their growth, but that fresh water most contributes to make them fat. Its agility in leaping over weirs, or any other obstacles which oppose its passage to

or from the sea, is surprising. They have been observed to throw themselves up cataracts and precipices many yards high; and when it so happens that their passage is effectually obstructed, they soon grow lean and sickly, and in a year or two's time languish away and die.

#### THE TORTOISE.



Q. Is not the tortoise a very curious fish?

A. The tortoise is an amphibious animal, living both by land and water. It is covered with an oval shell, beautifully clouded, and marbled with various colours, of which are made snuff-boxes, combs, &c. It is a dull, stupid animal, its brains being no bigger than a small bean, though its head is almost as big as a calf's.

They

They feed upon moss, grafs, or sea-weed. They are produced from eggs as big as those of a hen, only round as a ball ; of which they lay several hundreds in a season, near the sea-shore, covering them with sand ; and, about twenty-five days after laying, the eggs are hatched by the heat of the sun, and the little turtles, being about as big as young quails, run directly to the sea.

A tortoise of a common size will yield about 200 pounds of flesh, which the sailors preserve with salt ; and near 300 eggs, which will keep a considerable time. Some part of the flesh is white, and eats like veal, without any fishy taste ; and others are like mutton and beef.

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Q. Are there not other kinds of animals, besides birds, beasts, and fishes ?

A. Yes ; there are serpents and insects, some of the last of which are very curious, such as bees, ants ; and silk-worms.

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Q. What kind of creature is a silk-worm ?

A. The silk-worm is produced from a small egg, not much bigger than a mustard-seed, is of a pale ash-colour, and feeds on mulberry leaves, or, for want of these, on the leaves of lettuce. During

its continuance in this state, it suffers four returns of sickness, each lasting about three days, wherein it feeds not at all, but grows thicker, shorter, and clearer, and in each sickness changes its skin.

Soon after this, it begins to wind itself up into a silken bag or case, about the size of a pigeon's egg, in which state it lies inclosed about fifteen or twenty days without any food, and seemingly without life or motion, and is then transformed into an *Aurelia*, or *Chrysalis*, and, eating itself a passage out of the end of its silken sepulchre, becomes a moth, which is its last state, the state in which it lays eggs and dies.

These eggs are kept for about ten months, till the proper season returns, which is the beginning of May, and then they hatch of themselves into silk-worms. Those, who keep these insects, never suffer them to eat their way out of their silken habitation, because that would spoil their work; but towards the end of their continuance in their state, they wind the silk from off them, and the inclosed worm assumes its new state of a moth, as well as if it had continued the whole time in its silken covering.

The quantity of silk generally wound from one of these balls or cases is about 930 yards; but so  
extremely

extremely fine is the thread, that the weight of it is not above two grains and a half.

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Q. I have heard a great deal of the bees, and should be glad to receive a more particular account of them.

A. All that can be said with regard to these noble and useful insects, may be reduced to three heads, viz. their government, their œconomy, and their manner of working. That they are subject to laws and government, is asserted by all who have made observations upon them; and there is in every hive a certain bee of a larger size than the rest, which is looked upon by the community as their monarch, and obeyed with great loyalty.

Most naturalists are now of opinion, that this sovereign is a female, and the mother of all the hive; that those we call drones, which are larger and of a darker colour than the common bees, and of which there are not above 4 or 500 in each hive, are males; and that all the common working bees are neither male nor female.

Those who are furnished with glass hives, have been enabled to make many curious observations. They tell us, the queen has her apartments in the upper part of the hive; and when she appears in public, which is seldom, she walks with a sedate

and majestic air, and is attended by several large bees (probably the drones or males), who follow her with respect, or form a circle, and, fluttering their wings, seem mightily rejoiced to see her : that in any calamity, they take great care of her ; and if, by any misfortune, they are deprived of her, they neglect all business, as having no prospect of posterity to provide for, and either fly away at random, or languish and die.

As to their œconomy, all the business of the hive is carried on with surprising regularity, and the most entire union reigns throughout the whole community. Their habitations are in common ; their food and provision in common ; their labours all in common ; their cares of posterity in common ; they sympathize with one another in common danger, and with the greatest courage and resolution fight for one another.

They have no selfish views, no clashing or interfering interests ; but are perfectly happy in their united endeavours, which produce that affluence and plenty, that constitutes the riches of the whole community, and of every individual. They are patient of affronts when single, and at a distance from their hives ; but when within the reach of assistance from their fellows, they will not be disturbed in their labours without resenting it.

United,

United, however, as the bees are, and resolute in defence of one another, they are sometimes exposed to enemies they are unable to resist. One of their most formidable enemies is the mouse, which in cold weather, when the bees are not in vigour, will enter in at the mouth of the hive; and first gnaw the lowermost part of the comb, where there is but here and there a little honey; but waxing bolder as the cold weather increases, and the bees are more still, it ascends into the hive, and seizes on those combs which are next to the sides of the hive, where commonly the richest honey lies, and will eat holes through them, and so come and go through them at pleasure.

This attack of the mouse exposes them to other enemies, viz. the bees of other hives, who, smelling the fresh honey, come in like thieves when a neighbour's house is on fire, not to help, but to plunder them of their remaining goods. Besides the mouse, the chief enemies of the bee are the moth, the ear-wig, the hornet, the wasp, the swallow, and the sparrow, all of whom sometimes commit terrible devastations among them.

As to their manner of working, it is more astonishing than any other part of their history. When they begin to build their combs, they divide themselves into four bands; the first of which is con-



signed to the fields, to collect materials for the structure, which chiefly consist of the fine dust they gather from flowers, and which, mixed with a certain gluey substance, is made into wax. The second work upon these materials, and form them into a rough sketch of the dimensions and partitions of the cells, which are built hexagonal (that is, having six angles) with the nicest mathematical exactness. The third examine and adjust the angles, remove the superfluous wax, and polish and complete the work; and the fourth are waiters, who serve these labourers with provisions, during the time their work is in hand. And such is their diligence and industry, that generally, in a fortnight's time, the whole hive is filled with combs.

Bees swarm most in May and June, though sometimes in April and July. It is a very short-lived creature; few of them, it is thought, live above a year.

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Q. I should be equally obliged to you if you would give me some account of the ant.

A. As bees may be said to live under a monarch, so ants seem to form a kind of commonwealth or republic; and their industry appears to have been as well understood in ancient as it is in modern times. "Go to the ant, thou sluggard," says

Solomon, "consider her ways, and be wise, which, having no guide, overseer, or ruler, yet provideth her meat in the summer, and gathereth her food in the harvest."

The inside of an ant-hill is a kind of oblong city, divided into various streets, that terminate at different magazines. Some of the ants consolidate the earth, and prevent its falling in, by incrusting it over with a surface of glue. Others amass several splinters of wood, which they draw over the tops of their streets, and use them as rafters to support the roof, and across these they lay another row of splinters, and cover them with a heap of rushes, grass, and straw, which they raise with a double slope, to turn the current of the water from their magazines, some of which are appropriated to receive their provisions, and in others they deposit their eggs.

These eggs produce maggots, which after a time spin themselves coverings, and become *Aurelias*, and then ants. The affection of the parents for their young in the aurelia state is so strong, that, when danger threatens, they instantly run away with them, and will sooner die than leave them.

To prevent the corn, which they provide in the summer for their support in winter, from shooting or growing, they bite out the germs or bud  
before

before they lay it up ; and that the moisture of the earth may not occasion it to swell and rot, they provide a dry earth or sand to lay it in, and, when the sun shines hot, frequently bring it out of their holes to dry and harden it.

As to summer provisions, they take up with any thing that is eatable. You may see one loaded with the kernel of some fruit, another bending under the weight of a dead fly ; and sometimes several of them at work on a large substance, when what cannot be removed they eat on the spot, and carry home all that is capable of being preserved.

But the whole society is never permitted to make excursions at random. Some are detached as spies to get intelligence ; and, according to the tidings they bring, all the community (except such as are appointed to guard the city, and take care of their young) are upon their march, either to attack a ripe pear, a cake of sugar, or a treasure of grain. And their expedition to it, as well as their return from it, is under some regulation ; the whole band is ordered to assemble, and move in the same track : however, as they are a free people, these injunctions are never executed with much severity ; for if, by chance, they happen to spring a new game, they are at liberty to leave the track, and seize upon it.

VEGE-

## VEGETABLES.

Q. What do you mean by the Vegetable Kingdom?

A. Every thing that grows out of the earth, whether it be tree, plant, herb, or flower.

Q. Why is it called a kingdom?

A. That, as well as the doctrine of animals and minerals, are called kingdoms, because as kingdoms contain a great number of people, so each of these general heads contains a variety of particulars.

Q. What are the most remarkable vegetables?

A. The oak, the vine, the coffee tree, the tea-tree, the tobacco-plant, the sugar-cane, &c.

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Q. What kind of tree is the oak?

A. It is one of the largest and most useful of all vegetables: it is the strongest and most durable of all timber; and will continue firm and sound, either in air or water, longer than any other wood. Hence the great value it is of to ship-builders, carpenters, and other architects. It is produced  
from

from the acorn, a small fruit which it bears, very useful in feeding hogs and some other animals, and is said by naturalists to grow three hundred years.

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Q. What is a vine?

A. The vine is a plant or shrub of the reptile kind, supporting itself by creeping or climbing up any thing that stands near it. It is famous for its fruit, called grapes, which it produces in bunches, and from the juice of which is made that dangerous liquor, wine. I call it dangerous, because men very often drink it to the loss of their health and reason; but temperately used, its virtues cheer the heart, and enliven the imagination.

The best situation for a vineyard is a dry soil, on the side of a hill fronting the south; but generally the climate of England is too cold to bring this fruit to the perfection necessary to afford wines with any thing like the flavour of those produced in France, Spain, and Italy. There are various kinds of wine, which are generally denominated from the places where the vines grow. Thus Port comes from Portugal, Madeira from the islands of Madeira, and Burgundy and Champaign are the produce of those provinces in France.

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Q. What have you to say of the coffee-tree?

A. It

*A.* It is the tree that bears the coffee-berries. It grows very plentifully in Arabia, and is also cultivated in Turkey, and some parts of the Levant. The size of the berries is something bigger than our largest peas, the flower is like the white jessamin flower, and the leaf like that of the bay.

The berries are of a pale colour, and imported to us as they are gathered from the tree ; but, before they can be used to make the liquor which we call coffee, they are roasted in tin boxes, till they become of a deep brown colour, and then ground in a mill to powder.

The custom of drinking coffee is not of long standing in England. Some say Dr. Hervey was the first who used it ; others, that one Pasqua, a Greek servant, brought into England by Mr. Daniel Edwards, a Turkey merchant, in 1652, was the first who introduced it, and opened the first coffee-house in London.

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*Q.* What have you to observe concerning the tea-tree ?

*A.* The tea-tree grows in China, Japan, Siam, and other parts of the East Indies. It delights in vallies, and a stony soil. That which is imported to us, and of which we make tea, is only the leaves. They are gathered by the natives in  
March

March and April, held over the steam of boiling water to moisten them, and then laid on copper plates, and dried before the fire, which curls them in the manner we see.

Its seed is usually sown in places exposed to the south, and the tree bears three years after sowing. The root is somewhat like that of the peach-tree; the leaves are about an inch and a half long, narrow at the point, and jagged all round. Its flower resembles the wild rose, which, when blown, is succeeded by a cod, not exceeding the size of a hazel nut, containing two or three seeds, from whence the plant is propagated. The tree is said to be of various heights, even from one foot to an hundred.

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Q. What are the chief properties of the tobacco plant?

A. The tobacco plant is cultivated in several parts of America; but the greatest part of what is used in England, is imported from the province of Virginia. It likewise grows in other parts of the world, in most of our islands in the West-Indies, and particularly in Tobago, whence it had its name. It is propagated from seed, which is sown on pretty good ground, and for some time watered every day. In very hot weather it is protected

protected from the fury of the sun by branches of trees, or other things, thrown over it.

When it is risen to a certain height, they prepare a piece of ground for its reception, and transplant it much as we do lettuce; after which it is carefully weeded. The lower leaves are broke off, that they may not hang upon the ground, and rot; and when it begins to shew its flower, the heads also are cut off, that only twelve or fifteen of the principal leaves, receiving all the nourishment, may grow larger and of a thicker substance.

When ripe, the stalks are cut down, and hung up two by two under some shed or shelter from the sun and rain, and dried by the air for fifteen or twenty days. When the leaves are sufficiently dried, they are pulled from the stalks, made up into bundles, which, being wetted with sea or common water, are twisted into rolls, and in this manner imported into Europe; where the tobacco is cut with an engine cuts it for smoking, or grinds it for snuff, according to his occasions.

This plant was first brought into England by Sir Walter Raleigh, in the reign of Queen Elizabeth, which gave occasion, it is said, to the following curious incident. One morning while he was smoking a pipe of tobacco in his closet (a thing unknown to every body in England but himself),  
his



his servant entered with his breakfast (consisting of a tankard of ale and a toast ; for the use of tea was then unknown), and observing Sir Walter surrounded with a cloud of smoke, imagined, that by some unlucky accident he had caught fire ; upon which he threw the tankard of ale in his face, and ran out of the room, exclaiming, that his master was all in flames. Sir Walter was so well pleased with the humour of this adventure, that he forgave his servant for the pitiful plight into which he had put him.

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*Q.* Is not the sugar-cane a very curious plant ?

*A.* It certainly is : it is produced in many parts of the West Indies, particularly the Caribbee islands, as Barbadoes, Jamaica, St. Christopher's, &c. It usually grows five or six feet high, and is about half an inch in diameter. The stem, or stock, is divided by knots a foot and a half apart. At the top it puts forth a number of long green leaves, from the middle of which arise the flower and the seed. When ripe, which is commonly in about ten months, it is found quite full of a white juicy pith, from which is expressed the liquor whereof sugar is made.

The process of sugar is as follows : after the canes are cut, they are carried in bundles to the mills,

mills, which consist of three wooden rollers, covered with steel plates, and are wrought by water, or wind, or cattle, or slaves. The liquor, when the canes are broke and pressed between the rollers, runs through a little canal into the sugar-house, and is conveyed into a copper heated by a slow fire, just to make it simmer, where it receives its first separation. With the liquor is here mixed a quantity of ashes and quick lime; the effect of which mixture, assisted by the action of fire, is, that the unctuous parts are separated from the rest, and raised to the top in form of a thick scum, which is constantly taken off with a skimmer.

This done, it is further purified in a second, third, fourth, and fifth boiler, in which last it is brought to the consistence of a syrup. Then in a sixth boiler the syrup receives its full coction; and here all the impurities left by the former lees are taken away by a new lee, and a water of lime and alum is cast into it.

In this last copper there is scarce found one-third of what was in the first, the rest being waisted in scum. By thus passing a number of coppers, the sugar juice is purified, thickened, and rendered fit to be converted into any kind of sugar.

Q. Are there not many useful or curious trees and plants besides those you have mentioned?

A. Most

*A.* Most certainly: the cabbage-tree answers most of the purposes of garden-stuff; the bread-fruit tree, (lately found in some of the new-discovered islands in the South-sea, and happily, after various attempts, transplanted into the West India Islands) furnishes an eatable that is no bad succedaneum for bread made of grain; and the fir-tree produces pitch and tar, without which ships could not be properly built, at least not finished. The sun-flower is a most curious plant, that points its face towards the sun whichever way he turns.

MINERALS.

## MINERALS.

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*Q.* What do you mean by minerals?

*A.* Every thing dug out of the bowels of the earth.

*Q.* Are not these very numerous?

*A.* Certainly; and to talk of them all would not only be endless, but foreign to our present purpose. It will be more consistent with our design to make a few remarks upon metals, which are better known and more useful.

*Q.* How many kinds of metals are there?

*A.* Six, viz. gold, silver, copper, iron, lead, and tin; to which some add mercury as a seventh.

*Q.* What have you to say of gold?

*A.* Gold is the heaviest, purest, and most ductile of all metals. It is chiefly found in mines, though sometimes gold-dust is found in the sand and mud of rivers, particularly in Guinea; and hence the name for our largest gold coin. There are gold mines in most countries in the world, though in Europe they are very sparingly scattered. The mines of Chili and Peru in America are the richest,

2

though

though very fine gold is found in some parts of the East-Indies.

Of all the properties of gold its ductility is the most surprising. A single ounce of gold may be extended by the gold beater's hammer to a surface of near 150 square feet, and by the gold wire-drawers it will be extended to upwards of a thousand, yet remain so entire, as that the least flaw shall not be perceived, even by the help of the microscope.

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Q. What have you to observe with regard to silver?

A. Silver is a rich white metal, and, except gold, the finest and most ductile of any. There are silver mines in all parts of the world; but those of Peru, and some other parts of America, particularly those of Potosi, are by far the richest, and yield the ore in as great plenty as when first discovered; with this only difference, that the veins, which were then almost on the surface of that famous mountain, are now sunk so deep, that the workmen go down to them by a descent of almost four or five hundred steps.

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Q. What kind of substance is copper?

A. It is a hard, dry, heavy, ductile metal, and bounding

bounding in vitriol and ill-digested sulphur, and found in most parts of Europe, but particularly in Sweden. It is dug up in large fragments of ore, which are first beaten small, then washed to separate the earthy parts from it, then smelted and cast into a kind of molds to form large blocks, called salmons, or copper-cakes. This is the ordinary copper. There is a finer kind, called rose copper, and a still finer, called virgin copper, which is sometimes, but seldom, found pure in mines. It is the lowest-priced metal used for coin.

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2. What kind of substance is iron?

A. Iron is a hard, dry, fusible, and ductile metal, consisting of earth, salt, and sulphur, but all impure, ill mixed, and ill digested, which renders it liable to rust. By often heating it in the fire, hammering it, and letting it cool of itself, it is softened; by extinguishing it when hot in water, it is hardened. There are a great number of iron works in England; but the most considerable are those in the forest of Dean, in Gloucestershire, where the ore is found in great abundance. Though iron is the cheapest, it is certainly the most useful of all kinds of metal, and seems indispensably necessary to the carrying on every art and manufacture. Nay it appears to be the great means of

K

polishing

				Oz.	Dr.	Gr.
Gold	-	-	-	12	2	52
Mercury	-	-	-	8	6	8
Lead	-	-	-	7	3	30
Silver	-	-	-	6	5	28
Copper	-	-	-	5	6	36
Iron	-	-	-	5	1	24
Tin	-	-	-	4	6	17

**Q.** Are there not many other things contained in the bowels of the earth besides those you have mentioned?

**A.** Certainly.

**Q.** What are the principal of these?

**A.** 1. There are vast quarries of stone and marble, so useful in building. 2. There are mines of coal, so necessary to human life, particularly in those cold countries, where only they are found. And 3. there are various beds of clay, which serve the potter's use, the fuller's, or the brickmaker's. But there are two remarkable bodies that deserve a more particular attention; and these are, the diamond and the loadstone.

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**Q.** What is the diamond?

**A.** The diamond, by the ancients called adamant, is the most valuable of all precious stones. Its goodness consists in its water or colour, lustre, and

and weight; and its defects are flaws, veins, specks of red or black sand, and a blueish or yellowish cast.

Diamonds are found only in the East-Indies, sometimes in mines, and sometimes in the sand of rivers. It is the hardest of all gems, insomuch that it can only be cut and ground by itself, and its own substance.

The manner of preparing them is first to rub them hard against each other, and the dust, which is thus rubbed off the stones, serves to grind and polish them; and this is done by means of a mill, which turns a wheel of soft iron, sprinkled over with diamond dust mixed with oil of olives. The same dust, well ground, and diluted with water and vinegar, is used in the sawing of diamonds; which is performed with an iron or brass wire, as fine as a hair.

There are many other precious stones; and I will give you the names and colours of some of the principal. The ruby, which is next in value and esteem to the diamond, is of a crimson colour, somewhat inclining to a purple. The garnet is somewhat like it, and perhaps of the same species. The hyacinth is sometimes of a deep red, and sometimes of a yellow colour. The amethyst is of a bright purple. The emerald, a grass green.



The beryl, a sea or blueish green. The sapphire, a sky blue. The topaz or chrysolite is of a gold colour. These are all transparent.

There are others that are opaque, or only half transparent; such as the cornelian, which is the best, and of a pale red, sometimes bordering upon orange; the onyx, of a greyish cast; the turquoise, something between a blue and green; and the lapis lazuli, which is studded with spots of gold on an azure ground.

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Q. What is the magnet or loadstone?

A. This wonderful stone is usually found in iron mines, and is produced in most parts of the world; in China, Bengal, Arabia, Hungary, Germany, and England. It is a heavy stone, something resembling the ore of iron, only closer and more ponderous.

It is endowed with some surprising qualities and powers. It attracts iron, which will adhere to it very strongly; and this virtue it also communicates to the iron so attracted. In every magnet there are two poles, one of which points northwards, the other southwards; and if the magnet be divided into ever so many pieces, the two poles will be found in each piece.

It is this property which has rendered it so useful  
in

in improving the art of navigation; for this gave rise to the mariner's compass, by means of which a sailor can now conduct his ship to the East or West-Indies, or even round the world, with as much ease and as little danger as he could formerly make a voyage to the coast of Norway or Holland.

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*Q.* Have the improvements in ship-building kept pace with those in navigation?

*A.* They no doubt have. To be convinced of this, one need only consider the infinite difference there is between a first rate man of war and an Indian canoe, which seems to be little better than a large butcher's trough; and yet this was probably the first form of all sailing vessels.

Even after men had learned to build ships with more art and of a larger size, they never ventured out of sight of land without fear and trembling, because they could not tell whether they were sailing east or west, south or north, or to what part of the world they were going; but now, in the darkest night, and in the midst of the boundless ocean, they know the course they are steering with as much certainty as if it were in broad day and within sight of land.

# SEQUEL OF PHYSICS,

OR

## NATURAL PHILOSOPHY.

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### *Of Sound.*

Q. You said, in page 18, that sound moves 1142 feet in a second. Pray, can you tell how far sounds may be heard?

A. This is a matter not altogether certain; but there are reports of sounds (as the explosions of great guns, &c.) which have been heard at the distance of 180 or 200 miles.

Q. Can you give any instances of this?

A. Derham, in his *Physico-Theology*, says, that guns fired at Stockholm, in 1685, were heard at the distance of 180 English miles; and in the sea-fight between England and Holland, in 1672, the noise of the guns were heard even in Wales, which cannot be less than 200 miles.

Q. May not a low or languid sound be sometimes heard at a great distance?

A. It certainly may, as any one may satisfy himself by making the experiment in the whispering gallery of St. Paul's. Nay, it may be even heard  
so

so in the open air. Mr. Clare says, a gentleman of great veracity, who had lived some years at Gibraltar, assured him, that he has at old Gibraltar heard the watch-word of the night (*viz. All's well*) given by the centinel to the patrolle on the ramparts of new Gibraltar, in a still serene night, and the water perfectly smooth, and that as plain and distinctly, he thought, as he should have done had he been on the rampart himself. The bay between these two places is supposed to be about three Spanish leagues over, or about ten miles and a half.

Q. Does not the wind greatly obstruct the motion of sound?

A. Not so much as might be expected; though there is some small difference in the velocity of sound, according as it moves with or against the wind.

Q. How do you estimate the strength or intensity of sound?

A. That is always as the space passed through by the particles of undulating air, in their passive motion backward and forward. In a warm and rarefied air, whose elasticity is therefore small, the strength or intensity of sounds is not near so considerable as in a cold and denser air, when the elasticity of it is greater. The velocity of sound

is 52 times greater than that of a brisk wind, or current of air.

Q. Have you any thing else to say concerning the motion of sounds?

A. They pass through equal spaces in equal times, and nothing but the wind can accelerate or retard them. They are not in the least affected by the difference of day or night, of summer or winter, of heat or cold, of weather cloudy or clear, of air heavy or light, &c.

Q. Pray, Sir, what is the nature of that singular sound we sometimes hear, and which we distinguish by the name of an echo?

A. An echo is no more than the reverberation or repercussion of a sound from the surface of some very hard and smooth body, such as a wall, rock, &c. whence flying back, it re-salutes our ears with the same sound again.

Q. Can you mention any remarkable echos?

A. Dr. Plot, in his natural history of Oxfordshire, says, that the famous echo in Woodstock park returned 17 syllables in the day-time, when the wind was a little stirring, and 20 in the night-time; for then the air being denser, the vibrations became slower, and so a repetition of more syllables was heard. And Dr. Harris, in his technical dictionary, assures us, that there is a much finer echo

echo from the north side of Stepney church, in Suffex, which, in the night-time, would repeat these 21 syllables :

*Os homini sublime dedit, cælumque tueri  
Jussit, et erectos*————

### *Of Colours.*

Q. How many colours are there?

A. There are no more than seven original ones.

Q. What are they?

A. 1. Red. 2. Orange. 3. Yellow. 4. Green.  
5. Blue. 6. Indigo. 7. Violet.

Q. What is the difference of colours owing to?

A. It is owing to the different refrangibility of the rays of light that produce them.

Q. What do you mean by the refrangibility of the rays of light?

A. I mean their tendency to be turned out of a straight line, or to be rendered crooked, in passing through any medium.

Q. Which are the least refrangible rays?

A. Those that produce red.

Q. Which are the most refrangible?

A. Those that produce violet. And all the in-

intermediate rays produce the intermediate colours in the order above-mentioned.

*Q.* It should seem, from what you have said, that colours are only in the rays of light that produce them, and not in the bodies that are dyed with them. Is that your meaning?

*A.* It certainly is.

*Q.* Strange doctrine indeed! I am afraid you will get few people to be of your opinion.

*A.* I cannot help whether they be of my opinion or not; I know it is well founded: and that it is you may easily satisfy yourself by observing, that all bodies are of the same hue in the dark.

*Q.* If it be absolutely dark, we cannot see at all.

*A.* True: but there surely may be something between an obscure light and absolute darkness, just sufficient to shew us, that a man has got a coat upon his back, though we cannot tell for certain of what colour it is.

*Q.* But are black and white no colours?

*A.* No; they are no original colours: white is a mixture of all these colours; black a privation of them all, or no colour at all.

*Of the Air.*

**Q.** What other properties does the air possess besides those you have already mentioned?

**A.** 1. The air may be rarefied and condensed.  
2. It is endued with an elastic power or force.  
3. It hath weight or gravity. 4. It hath proper bounds or limits, and is not infinite. And 5. It is necessary to the life of animals, and the growth of vegetables, and to many other things.

**Q.** How does it appear that the air may be rarefied?

**A.** Thus: if you take a bladder, entirely empty, as you think, and tie its neck with a string, and lay it before the fire, the heat will so rarefy the little air inclosed in it, as to make it extend the bladder to its utmost stretch, and, if continued, will make it break through with the report of a gun.

That the air may be condensed, even to a sixtieth part of the space it before occupied, is proved by a variety of experiments.

**Q.** How can you shew the air's elasticity?

**A.** By experiments with the air-pump, and otherwise. One very simple one is this: an empty bladder, whose neck is tied fast, being put



into the receiver, and the external air contained in it exhausted, the small quantity of air inclosed in the bladder will, by its own proper spring or elastic force, gradually expand itself, and at last will so extend the bladder as to break it.

Thus also, the air compressed in the wind-gun will, by its elastic force when discharged, drive a bullet through a board at the distance of several yards, in the same manner as if it were with gun-powder.

Nay, Mr. Boyle found, that air, by its elasticity, would so far dilate or expand itself, as to take up 13,769 times more space than before.

Q. How do you prove the weight or gravity of the air?

A. By experiments with the air-pump, barometer, &c. The weight of the air is greater, the nearer it is to the surface of the earth. The mercury in the barometer, by the pressure of the air, is raised to the height of 28, 29, 30, or 31 inches; therefore such a column of mercury is equal in weight to a column of air (of an equal base), which rises from the same level as the mercury at the bottom of the barometer, to the uppermost part of the atmosphere. Moreover, since mercury is about fourteen times heavier than water, water will rise in a tube to 32 or 33 feet in height; and therefore  
every

every square foot in any superficies sustains the weight of a column of water of 32 or 33 solid feet. Now a cubic foot of water weighs about 63 pounds; and hence it follows, that the weight of air on every superficial square foot is above 2000 pounds.

Q. May not many curious inferences be drawn from thence?

A. Certainly; here is one: suppose the surface of a man's body (of a middling size) to be about 14 square feet, then the weight of the air pressing upon him is equal to 28,000 pounds, or 250 hundred weight; that is, twelve tons and a half.

Q. This is very surprising. But if men—and, I suppose, the case is the same with all other animals, and indeed with all bodies whatever—are pressed by so great a weight, how comes it that they are not crushed to pieces?

A. They are preserved by the re-action of the internal air, or the air within them, which maintains a kind of balance or equilibrium.

Q. Are animals sensible of this pressure of the air upon them?

A. No: on the contrary, they would be extremely sensible of the want of it, were it withdrawn from them. In that case, indeed, they could neither breathe, nor even live, but would  
very

very soon die, as is evident from the experiments performed by the air-pump.

Q. What is the air-pump ?

A. It is a curious machine for extracting the air from a large hollow glass, called a receiver, somewhat resembling those glasses that are used in gardens for covering tender plants. Into this glass if any animal is put, and the air drawn from it, it will almost immediately die.

Q. Do all animals die in the air-pump in the same space of time ?

A. Not exactly. Some die sooner and some later, either according to the strength of the vital principle within them, or according as they have been accustomed to live with more or less air. Dogs, cats, rats, and mice, die in about half a minute ; a mole dies in one minute ; insects, such as wasps, bees, hornets, and grasshoppers, appear dead in two minutes, and will continue in that state a whole day and night, and afterwards revive upon the readmission of the air ; earwigs, beetles, and snails live a long time without air ; and frogs will live longer without it than toads.

Q. It certainly must be curious to observe these artificial deaths and resurrections. But is it not cruel thus to put animals to death, merely for the sake of experiments ?

A. It

*A.* It no doubt is; and therefore philosophers have invented a machine, called the lungs-glass, which answers almost the same purposes.

*Q.* What else have you to say of the air-pump?

*A.* In the exhausted receiver of an air-pump all bodies fall with the same rapidity: a feather falls as fast as a guinea; that is, the lightest of all bodies falls as fast as the heaviest.

*Q.* May not many other curious experiments be performed by the air-pump?

*A.* Certainly: here follow a few of them.

1. Put a shrivelled apple under a close receiver, and exhaust the air; then the spring of the air within the apple will plump it out, so as to make all the wrinkles disappear; but upon letting the air into the receiver again, to press upon the apple, it will instantly return to its former decayed and shrivelled state.

2. Take a fresh egg, and cut off a little of the shell and film from the smallest end, then put the egg under the receiver, and pump out the air; upon this all the contents of the egg will be forced out into the receiver, by the expansion of a small bubble of air contained in the great end between the shell and film.

3. Set a bell upon a cushion on the pump plate, and cover it with a receiver; then shake the pump

to make the clapper strike against the bell, and the sound will be very well heard. But exhaust the air out of the receiver, and then, if the clapper be made to strike ever so hard against the bell, it will make no sound at all; which shews, that air is absolutely necessary for the propagation of sound.

Q. Have you any thing else to say concerning the nature of air?

A. The elastic air which is contained in many bodies, and is kept in them by the weight of the atmosphere, may be got out of them either by boiling, or by the air-pump; but the fixed air, which is by much the greater quantity, cannot be got out but by distillation, fermentation, or putrefaction.

Q. What would you infer from hence?

A. What I would infer from it is, that this is a very wise law of providence; for if fixt air did not come out of bodies with difficulty, and spend some time in extricating itself from them, it would tear them to pieces. Trees would be rent by the change of air from a fixt to an elastic state, and animals would be burst in pieces by the explosion of air in their food.

Q. How does this appear?

A. Dr. Hales found, by experiment, that the air in apples is so much condensed, that, if it  
were

were let out into the common air, it would fill a space 48 times as great as the apples themselves ; so that its pressure outward was equal to 11,776 pounds, and, in a cubic inch of oak, to 19,860 pounds against its sides.

If, therefore, the air were let loose at once in these substances, they would tear every thing to pieces about them with a force superior to that of gun-powder. Hence, in eating apples, it is well that they part with the air by degrees, as they are chewed, and ferment in the stomach, otherwise an apple would be immediate death to him that eats it.

Q. What other properties of the air can you mention?

A. Common air is impregnated with a certain kind of vivifying spirit or quality, which is necessary to continue the lives of animals ; and this, in a gallon of air, is sufficient for one man during the space of a minute, and no longer.

Q. How do you know that a man will consume the vivifying spirit of a gallon of air in a minute?

A. By the diving bell, in which, if a man descend into the deep, he can only live as many minutes as the number of gallons of air contained in the bell amount to. Even a burning candle consumes

fumes the vivifying spirit of a gallon of air in a minute.

*Q.* How does this appear?

*A.* By the following experiment: Set a lighted candle upon the air-pump, or indeed upon any other place so smooth, that, when covered with a receiver, no air can enter. If the receiver holds a gallon, the candle will burn a minute; and then, after having gradually decayed from the first instant, it will go out; which shews, that a constant supply of fresh air is as necessary to feed flame, as it is to support the lives of animals.

*Q.* May not this vivifying spirit of air be destroyed?

*A.* Certainly, and that too in a variety of ways. First, by passing through the lungs of animals, as is evident from what we have just now said. Secondly, by passing through fire, particularly charcoal fire, or the flame of sulphur. Hence smoky chimnies must be very unwholesome, especially if the rooms they are in be small and close. Thirdly, by being long pent up in any close place, such as the holds of ships, oil-cisterns, or wine-cellar. The air in many of these is sometimes so corrupted, as to prove instant death to any animal that comes into it.

*Q.* Does not this air go by a particular name?

*A.* It

*A.* It is called *Damp*; not only because it is filled with humid or moist vapours, but because it deadens fire, extinguishes flame, and destroys life. The dreadful effects of damps are sufficiently known to those who work in mines.

*Q.* May not the air be greatly condensed?

*A.* It may be so much condensed in what is commonly called the air-gun, that it will throw out a ball with almost as much force as if it were done with gun-powder.

*Q.* Is there not another kind of air-gun that will produce still more surprising effects?

*A.* Yes; there is a gun, called the magazine air-gun, in which the air may be so condensed, as to make it shoot a number of balls, one after another, with incredible force.

*Q.* May not the air be rarefied as well as condensed?

*A.* Yes; and the rarefaction of it gives rise to many singular phenomena. The rarefaction of it in the atmosphere produces wind; and the rarefaction of it in the bowels of the earth is supposed to be the cause of earthquakes.

*Q.* Is it not possible to make an artificial earthquake?

*A.* An artificial earthquake may be made thus :  
Take 10 or 15 pounds of sulphur, and as much of  
the



the filings of iron, and knead them with common water into the consistency of a paste. This being buried in the ground, will, in 8 or 10 hours time, burst out in flames, and cause the earth to tremble all around to a considerable distance.

From this experiment we have a very natural account of the fires of mount *Ætna*, *Vesuvius*, and other volcanos, they being probably set on fire at first by the mixture of such metalline and sulphurous particles.

Q. Is not this property of air, viz. its power of being rarefied and condensed, the same with its spring or elasticity?

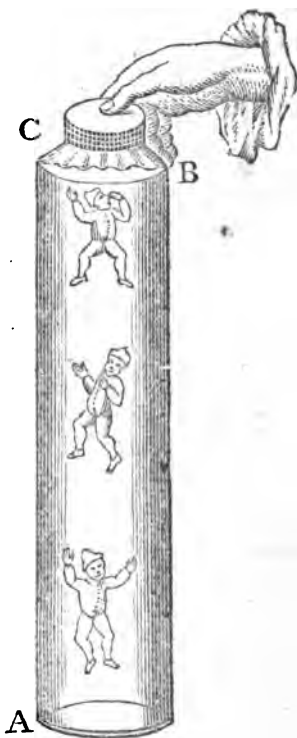
A. It is; and upon this depend many curious phenomena, particularly that entertaining one, by which the little glass-men are made to ascend and descend, at the word of command, in a glass-tube of water.

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Q. How

2. How is this experiment performed?

A. The men being blowed hollow, are thereby rendered lighter than water, and will swim in it; and having a small hole in one foot, and a bladder tied over the top of the tube, as C B, if this be pressed with the fingers, the included air, by its spring, will equally press the water, which will enter the feet of the men, and compress the air in them, and thereby render them heavier in any degree. If they are by this means brought to the



same gravity with the water, they will abide in any situation you please. If they are rendered heavier by pressing the bladder harder, they will descend; the fingers being taken

taken off, or the pressure diminished, the spring of the included compressed air forces the water out of the men, which thus becoming lighter, ascend to the top ; and all these motions may be varied in any degree of quickness or slowness the performers think proper.

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OF  
WATER AND WATER ENGINES,  
COMMONLY CALLED  
HYDRAULIC MACHINES.

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*Q.* What is water?

*A.* It is a fluid, as well as air, (all its parts yielding easily to the slightest pressure) only it is of a more heavy and compact body.

*Q.* How high will water rise in a pump?

*A.* It will rise to the height of 32 or 33 feet, and no higher, unless it be driven up by a forcing engine?

*Q.* What is the reason of this?

*A.* The reason of it is, that the water without the pump is pressed upon by the whole weight of the air above it; and it has been found by experiment, that the weight of a column of air from the top of the atmosphere to the earth, is equal to the weight of a column of water of the same diameter 32 or 33 feet high.

*Q.* Well; but how does this affect the water in the pump?

L

A. I

*A.* It would not affect it at all, were not the air drawn out of the pump by means of the piston; and then the water rises in the pump, to preserve an equilibrium.

*Q.* I think I have heard it said, that water may be conveyed in pipes over hills and vallies to any distance: may it really be so?

*A.* It certainly may; but then it must be observed, that the water will never rise higher than the head of the fountain from which it comes.

*Q.* I have likewise heard it said, that wood may be made to lie at the bottom of the water, as if it were a stone. Is that possible?

*A.* It is very possible?

*Q.* How is it done?

*A.* Let two pieces of wood be planed so smooth as that no water can get between them when they are put together. Cement one of them to the bottom of a tub: lay the other piece upon it, and hold it down with a stick, while you pour water into the tub till it is full. Then take away the stick, and you will see the upper piece of wood remain glued as it were to the under piece, though it is kept down by nothing but the pressure of the water above it. But if once the water get between the two pieces of wood, the upper piece will immediately ascend, and swim on the surface.

*Q.* That

**Q.** That is very strange ?

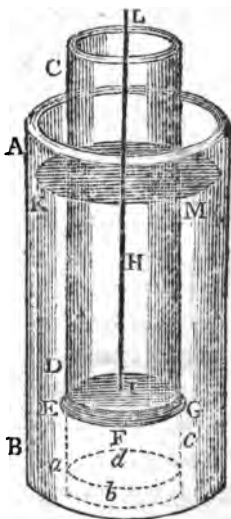
**A.** It no doubt is ; but you will think it still more strange when I tell you, that as wood may be made to lie at the bottom of water as if it were a stone, so lead may be made to swim in water as if it were a piece of wood.

**Q.** That, I think, is impossible ?

**A.** And yet, that it is possible, you may easily be satisfied by making the experiment yourself.

**Q.** How shall I make it ?

**A.** Thus. Let C D be a glass tube, open at both ends, and E F G a flat piece of lead, exactly fitted to the lower end of the tube, not to go within it, but for it to stand upon ; with a wet leather between the lead and the tube to make close work. Let this leaden bottom be half an inch thick, and held close to the tube by pulling the packthread I H L upward at L with one



hand, whilst the tube is held in the other by the  
L 2 upper

upper end C. In this situation, let the tube be immersed in water in the glass vessel A B to the depth of six inches below the surface of the water at K; and then the leaden bottom E F G will be plunged to the depth of somewhat more than eleven times its own thickness: holding the tube at that depth, you may let go the thread at L; and the lead will not fall from the tube, but will be kept to it by the upward pressure of the water below it (for water presses upward as well as downward), occasioned by the height of the water at K above the level of the lead.

For as lead is about 11 times as heavy as its bulk of water, and is in this experiment immersed to a depth somewhat more than 11 times its thickness, and no water getting into the tube between it and the lead, the column of water E a b c G below the lead is pressed upward against it by the water K D E G L all around the tube; which water being a little more than 11 times as high as the lead is thick, is sufficient to balance and support the lead at the depth K E.

If a little water be poured into the tube upon the lead, it will increase the weight upon the column of water under the lead, and cause the lead to fall from the tube to the bottom of the glass vessel, where it will be in the situation b d. Or, if the  
tube

tube be raised a little in the water, the lead will fall by its own weight, which will then be too great for the pressure of the water around the tube upon the column of water below it.

Q. I have heard a great deal of the syphon as being a very curious machine.

A. It is not only very curious, but likewise extremely useful to all people that deal in wine, or other liquors.

Q. I should be glad to have some short account of it.

A. Here follows a very brief one. A syphon, generally used for decanting liquors, is a bended pipe, whose legs are of unequal lengths; and the shortest leg must always be put into the liquor intended to be decanted, that the perpendicular height of the column of liquor in the other leg may be longer than the column in the immersed leg, especially above the surface of the water.

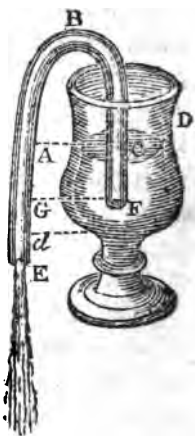
For, if both columns were equally high in that respect, the atmosphere, which presses as much upward as downward, and therefore acts as much upward against the column in the leg that hangs without the vessel, as it acts downward upon the surface of the liquor in the vessel, would hinder the running of the liquor through the syphon, even though it were brought over the bended part by



suction. So that there is nothing left to cause the motion of the liquor, but the superior weight of the column in the longer leg, on account of its having the greater perpendicular height.

Q. I should be glad to have this illustrated by a figure.

A. Here then I present you with one. Let D be a cup filled with water to C, and A B C a syphon, whose shorter leg B C F is immersed in the water from C to F. If the end of the other leg were no lower than the line A C, which is level with the surface of the water, the syphon would not run, even though the air should be drawn out of it at the mouth A. For although the suction would draw some water at first, yet the water would stop



at the moment the suction ceased, because the air would act as much upward against the water at A, as it acted downward upon it by pressing on the surface at C.

But if the leg A B comes down to C, and the air be drawn out at G by suction, the water will immediately follow, and continue to run, until the surface

surface of the water in the cup comes down to F; because, till then, the perpendicular height of the column B A G will be greater than that of the column C B; and consequently its weight will be greater, until the surface comes down to F; and then the syphon will stop, though the leg C F should reach to the bottom of the cup. For which reason the leg, that hangs without the cup, is always made long enough to reach below the level of its bottom; as from *d* to E: and then, when the syphon is emptied of air by suction at E, the water immediately follows, and by its continuity brings away the whole from the cup; just as pulling one end of a thread will make the whole clue follow.

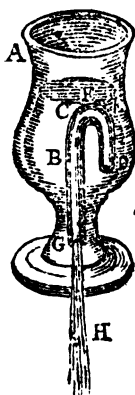
If the perpendicular height of a syphon from the surface of the water to the bended top at B, be more than 33 feet, it will draw no water, even though the other leg were much longer, and the syphon quite emptied of air; because the weight of a column of water 33 feet high is equal to the weight of as thick a column of air, reaching from the surface of the earth to the top of the atmosphere; so that there will then be an equilibrium, and consequently, though there would be weight enough of air up the surface C to make the water ascend in the leg C B almost to the height B, if the sy-

phon were emptied of air, yet that weight would not be sufficient to force the water over the bend; and therefore it could never be brought over into the leg B A G.

Q. Is there not a kind of syphon called *Tantalus's cup*?

A. Yes, and it is formed thus. Let a hole be made quite through the bottom of the cup A, and the longer leg of the bended syphon D E B G be cemented into the hole, so that the end D of the shorter leg D E may almost touch the bottom of the cup within. Then, if water be poured into this cup, it will rise in the shorter leg by its upward pressure, driving out the air all the way before it through the longer leg; and when the cup is filled above the bend of the syphon at F, the pressure of the water in the cup will force it over the bend of the syphon; and it will descend in the longer leg C B G, and run through the bottom, until the cup be emptied.

In order to make the figure the more striking, a little hollow statue or figure of a man is sometimes put over the syphon to conceal it; the bend E being within the neck of the figure as high as the chin.



chin. So that poor thirsty *Tantalus* stands up to the chin in water, imagining it will rise a little higher, that he may drink; but, instead of that, when the water comes up to his chin, it immediately begins to descend, and, as he cannot stoop to follow it, he is left as much pained with thirst as ever.

Q. Do bodies weigh equally in air and in water?

A. No; they weigh much heavier in the former than they do in the latter, and it is by weighing them in these two different mediums that we find out their weights bulk for bulk, or what is commonly called their specific gravity.

Q. How was this art first invented?

A. By the following curious accident. Hiero, king of Syracuse, having employed a goldsmith to make a crown, and given him a mass of pure gold for that purpose, suspected that the workman had kept back a part of the gold for his own use, and made up the weight by alloying the crown with copper. But not knowing how to find out the cheat (if there was any), he referred the matter to Archimedes; who having studied a long time in vain, at last found it out in the following manner.

One day, upon his going into a bathing tub of water, he observed, that he thereby raised the water higher in the tub than it was before. From this he concluded, that he had raised the water just

as high as any thing else of the same bulk with himself could have done ; but not so high as another body of equal weight, and larger bulk, would have raised it. He then went to the king, and told him that he had found out a method by which he could discover the deceit of the goldsmith, if he had been guilty of any.

For, since gold is the heaviest of all metals, it must be of less bulk, according to its weight, than any other metal. And therefore he desired, that a mass of pure gold, equally heavy with the crown, when weighed in air, should be weighed against it in water ; and if the crown was not alloyed, it would counterpoise the mass of gold when they were both immersed in water, as well as it did when they were weighed in air.

But, upon making the trial, he found that the mass of gold weighed much heavier than the crown did. And not only so, but that, when the mass and crown were immersed separately in the same vessel of water, the crown raised the water much higher than the mass did ; which shewed it to be alloyed with some lighter metal that increased its bulk. And so, by making trials with different metals, all equally heavy with the crown when weighed in air, he found out the quantity of alloy in the crown.

## ADDITIONAL REMARKS

ON

## GEOGRAPHY.



*Q.* Are there not many curious things in Geography, at least in the scientific part of it, besides those you have mentioned?

*A.* There certainly are.

*Q.* What are they?

*A.* To mention them all would exceed the limits of this short Appendix. I shall content myself at present with pointing out a few of the most remarkable.

*Q.* What are these?

*A.* It is certainly very remarkable, that, though the earth be nearer the sun in winter than it is in summer, it is yet much colder in the former of these seasons than it is in the latter.

*Q.* What! the earth nearer the sun in winter than it is in summer! This is very strange indeed, and contrary to all appearances.

*A.* It may be so, and yet it is an undoubted truth; but to understand it perfectly requires a

greater knowledge of astronomy than you can as yet be supposed to have attained. You must therefore, for the present, take the fact for granted.

Q. Well, supposing I take it for granted, I may yet be allowed to ask the reason why the weather is much colder in winter than it is in summer?

A. This is owing to a variety of causes. In the first place, the nights are longer in winter than the days, and consequently more heat is taken out of the earth in the night time than is infused into it in the day time; and hence it is, that the weather is always growing colder and colder in winter, as, for a contrary reason, it is always growing hotter and hotter in summer.

In the next place, the rays of the sun fall more obliquely upon the earth in winter than they do in summer, and therefore have a much less powerful effect.

It must be observed, however, that what we call summer and winter relates only to our northern latitudes, and to the opposite southern latitudes equally distant from the equator; for at the equator itself, and to the distance of about 23 degrees and an half from it on each side, they have, properly speaking, no summer or winter at all. They have only, in lieu of them, their wet and dry, or  
6 their

their fair and rainy seasons; but during both these, the progress of vegetation is still carried on, and is never stopped, as it frequently is with us during the cold months of winter.

Q. What else remarkable have you to mention?

A. It is certainly somewhat singular, and yet undoubtedly true, that we see the sun for some minutes before he actually rises, and for the same space of time after he really sets.

Q. This is certainly strange; but how can it happen?

A. It happens in this manner. The rays of the sun, both at his rising and setting, pass through a large body of thick air, by which they are turned out of a straight line, and bent into a crooked or oblique direction, representing all distant objects, as being much higher than they are in reality; and the sun, the most distant of all visible objects, at least by day, is subject to the same law as other bodies. Thus he is visible, or appears above the horizon, before he really rises; as he is likewise visible, or appears above the horizon, after he actually sets; I mean, before he either rises or sets strictly and mathematically speaking.

Q. I think I have heard it said, that there are some parts of the earth where the days and nights are always equally long?

A. What



*A.* What you have heard is true ; for this is the case at the equator. The days there are always twelve hours long, and the nights are of the same length.

*Q.* Are there not likewise some parts of the earth where there is only one day and one night during the whole year ?

*A.* There certainly are, and that is at the two poles : for there the sun is visible, or appears above the horizon, for six months ; and during the other six months, he is invisible, or sunk below the horizon.

*Q.* I should like dearly to live at the pole, where the day is of six months continuance : it must be a charming summer : and then, when he began to move towards the other pole, I should wish to follow his course, and take up my residence at the opposite part of the globe ; thus shifting my quarters, as the phrase is, according to the seasons, in much the same manner as our countrymen go to the south of France, and to Portugal and Italy, during the cold months of winter.

*A.* You are pleased to be witty, Sir ; but perhaps you would not find your habitation at the poles to be so very comfortable as you seem to imagine : for it is yet a doubt among philosophers whether the poles do not consist of solid ice, or at least are

not

not surrounded with islands of ice. No man, not even the boldest navigator, has ever yet been able to reach, or to approach nearer to it than to within the distance of about nine degrees, that is, about 600 miles. This was done some years ago by the late Lord Mulgrave, when he was only Capt. Phipps, who perhaps came nearer it than any man ever did before.

Q. Are there not some parts of the world where the sun, at certain seasons of the year, is in the zenith of the inhabitants, that is, directly over their heads?

A. Yes; this happens in all places in the torrid zone, or between the tropics of Cancer and Capricorn; that is, for an extent of 47 degrees, or 3266 miles in breadth; and in all these places, the sun is vertical, or directly over the heads of the inhabitants, not only once, but even twice a year, except at the tropics themselves, where it is vertical only once.

Q. It must surely be excessively hot in those countries: is it not?

A. It is so in general, though not so much as one would imagine; for when the sun is vertical, it is commonly their cloudy or rainy season, which serves to intercept his rays, and to cool the surface of the earth.

Q. What

Q. What is the circumference of the earth?  
I mean, how miles is it round?

A. 25,058 miles.

Q. Was it ever sailed round?

A. Frequently; first by Magellan, a Spaniard; afterwards by Sir Francis Drake, our own countryman; and, in later times, by Commodore Byron, Captains Cook, Furneaux, Carteret, Wallis, and others.

Q. What discoveries did these circumnavigators make?

A. The two first made very few; but the last have found that the great South-sea, in certain latitudes, is covered with an infinite number of islands, and one of them in particular, called New South Wales, so large, that it almost deserves the name of a continent.

Q. I think I have heard of a remarkable circumstance that occurs according as a ship directs her course east or west in sailing round the world. Is there not such a one?

A. There certainly is, and it is this. If a ship sets out from any port, and sails round the earth eastward to the same port again, let her take what time she will to do it in, the people in that ship, in reckoning their time, will gain one complete day at their return, or count one day more than

than those who reside at the same port ; because by going contrary to the sun's diurnal motion, and being forwarder every evening than they were in the morning, their horizon will get so much the sooner above the setting sun than if they had kept for a whole day at any particular place. And thus, by cutting off a part proportionable to their own motion, from the length of every day, they will gain a complete day of that sort at their return ; without gaining one moment of absolute time more than is elapsed, during their course, to the people at the port.

If, on the other hand, they sail westward, they will reckon one day less than the people do who reside at the said port, because, by gradually following the apparent diurnal motion of the sun, they will keep him each particular day so much longer above the horizon, as answers to that day's course ; and, by that means, they cut off a whole day in reckoning, at their return, without losing one moment of absolute time.

Hence, if two ships should set out at the same time from any port, and sail round the globe, one eastward and the other westward, so as to meet at the same port on any day whatever, they will differ two days in reckoning their time, at their return. If they sail twice round the earth, they  
will

will differ four days; if they fail thrice, they will differ six days; if four times, eight days, &c.

## OF THE WINDS.

Q. I should like to have a more particular account of the winds than any I have yet received: will you be pleased to give it me?

A. I will endeavour to do so.

Q. I shall be much obliged to you.

A. You know then, as I formerly told you, that wind is chiefly occasioned by a rarefaction of the air; for when the air is rarefied, it naturally ascends into the higher regions; and the circumjacent air, which is thicker and heavier, immediately rushes in to supply its place, and fill up the vacancy. This motion of the air we call wind, and we give it the name of a breeze, a gale, or storm, according to the quickness or velocity of its motion.

Q. All this I perfectly understand, and very well remember. But I wish you would be a little more particular. Are there not certain winds, called tropical winds, which blow almost always from the same point of the compass?

A. There

*A.* There are, and they are of three kinds.

1. The *general trade winds*, which extend to near thirty degrees of latitude on each side of the equator, in the Atlantic, Ethiopic, and Pacific oceans. On the north side of the equator, they blow from north-east, on the south side from south-east, and near the equator from almost due east.

2. The *monsoons*, or shifting trade winds, which blow six months in one direction, and the other six months in an opposite direction. These are mostly in the Indian or Eastern ocean, and do not reach above two hundred leagues from the land. Their change is at the vernal and autumnal equinox, and it is accompanied with terrible storms of thunder, lightning, and rain.

3. *The land and sea breezes*, which are periodical winds, and blow from the land from night to about mid-day, and from the sea from about noon to mid-night. These winds do not extend above two or three leagues from the shore.

Beyond the latitude of thirty degrees, north and south, the winds, as we daily perceive in Great Britain, are more variable, though it may be observed in general, that the tendency of the wind is from a colder region to that which is hotter.

OF

## OF THE TIDES.

Q. What have you to observe of the tides besides what you formerly mentioned ?

A. It must first be observed, that the sun attracts the earth, as well as the moon does ; but he attracts it, however, with much less force, on account of his infinitely greater distance.

Q. When have we the highest tides ?

A. At the new and full moon, and the tides then are called spring tides ; for at these times the actions both of the sun and moon are united, and draw in the same straight line, and consequently the sea must be more elevated. At the conjunction, that is, the new moon, when the sun and moon are on the same side of the earth, they both conspire to raise the waters in the zenith, and consequently in the nadir ; and at the opposition, or full moon, when the earth is between the sun and moon, while one occasions high water in the zenith and nadir, the other does the same.

Q. When do the lowest tides happen ?

A. The lowest tides, or (as they are usually called) the neap tides, happen about the first and last quarters of the moon ; for then the influence  
of

of the sun and moon counteract each other: the sun raises the waters where the moon depresses them, and depresses where the moon raises them; so that the tides are only occasioned by the difference, by which the action of the moon, which is nearest us, prevails over that of the sun.

Q. Do these things happen regularly?

A. They would do so, were the whole surface of the earth covered with water; but as there is a multitude of islands and continents, which interrupt the natural course of the water, a variety of appearances are to be met with in different places, which cannot be explained without regarding the situation of shores, straits, and other objects, which have a share in producing them.

Q. Are there not various currents in the sea?

A. Yes; there is a current between Florida and the Bahama islands, which always runs from north to south. A current runs constantly from the Atlantic, through the straits of Gibraltar, into the Mediterranean. A current sets out of the Baltic sea, through the Sound or strait between Sweden and Denmark, into the British ocean, so that there are no tides in the Baltic.

Q. But if a current constantly runs from the Atlantic into the Mediterranean, is it not strange that the waters of the sea do not increase?

A. No:



*A.* No : the water extracted from it in vapours is more than sufficient to counterbalance the influx,

*Q.* How does this appear ?

*A.* It has been found by calculation, that in a summer's day, there may be raised, in vapours, from the Mediterranean 5280 millions of tons of water, yet this sea receives not from all its nine great rivers above 1827 millions of tons per day, which is but one third of what is exhausted in vapours ; so that, were it not for the influx from the Atlantic, the Mediterranean would soon be rendered dry.

*Q.* How high do the tides ever rise ?

*A.* About small islands, and headlands in the middle of the ocean, the tides rise very little ; but in some bays, and about the mouths of rivers, they rise from 12 to 50 feet.

*Q.* Are the tides always highest precisely at the time of the new and full moons ?

*A.* No ; they are generally highest about three tides after.

*Q.* Are the same tides (viz. spring and neap) of the same height in the same place all the year round ?

*A.* No ; for as I have already said, the earth is somewhat nearer the sun in winter than it is in summer ; and therefore the greatest equinoctial  
tides

tides are observed to happen some time before the vernal equinox, and a little after the autumnal one.

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## ELECTRICITY.

**Q.** Whence comes the word electricity?

**A.** From the Greek word *ηλεκτρος*, signifying amber, which was the first substance that was observed to have the property of attracting straws, and other light bodies; for this was the simple origin of a science that is now arrived at very great perfection.

**Q.** Is not the word electricity commonly taken in a more extended sense?

**A.** It is commonly understood to mean the electrical matter, or the art of putting that matter in motion, or calling it into motion.

**Q.** What is the electrical matter?

**A.** It is a subtle fire that pervades all nature, and produces the most surprising effects.

**Q.** What are the principal of these effects?

**A.** Thunder and lightning is undoubtedly one of them; earthquakes are probably, at least in some

some measure, another; and it is even supposed by some philosophers, that the *Aurora Borealis*, or northern lights, are owing to the same cause.

Q. How does it appear, that thunder and lightning are owing to electricity?

A. Dr. Franklin has proved, by a variety of experiments, that the lightning of electricity and the lightning that flashes from the clouds in a thunder storm, are exactly of the same kind, and operate in the same manner.

Q. I should be glad to hear the particular points, in which these two kinds of lightning agree, and produce the same or similar effects.

A. You are right in saying similar; for though they are certainly the same in kind, they are not always the same in degree: the works of men can never equal the operations of nature.

Q. In what respects, then, do they agree?

A. I shall inform you almost in the doctor's own words; after observing, that electricians have the art of making a machine, by which they can draw fire from a variety of bodies, and even accumulate, or heap it together in such quantities, that when it is discharged, or let off, it will make a report like a pistol, and even kill animals.

Q. I should like to see such a machine?

A. You may see it at the shop of any maker  
of

of mathematical instruments, and such are to be found in every capital town in the kingdom. But to describe to you a machine, which you could not make, would be not only dry and uninteresting, but almost unintelligible. You must, therefore, at present, take the thing for granted.

.Q. Very well; proceed, if you please, with the particulars, in which these two kinds of lightning agree.

A. Here, then, they follow :

1. Flashes of lightning, says the doctor, are generally seen crooked, and waving in the air. The same, adds he, is the electric spark always, when it is drawn from an irregular body at some distance.

2. Lightning strikes the highest and most pointed objects in its way preferable to others, as high hills and trees, towers, spires, masts of ships, points of spears, &c. In like manner, all pointed conductors\* receive or throw off the electric fluid more readily than those that are terminated by flat surfaces.

\* Conductor is a term used by electricians for denoting any thing that conducts the electric fire from one body to another.

3. Lightning is observed to take the readiest and best conductor. So does electricity in the discharge of the Leyden phial.\*

For this reason the doctor supposes, that it would be safer, during a thunder storm, to have one's cloaths wet than dry, as the lightning might then, in a great measure, be transmitted to the ground, by the water on the outside of the body. It is found, he says, that a wet rat cannot be killed by the explosion of the electrical bottle, but that a dry rat may.

4. Lightning burns: so does electricity. Dr. Franklin says, that he could kindle with it hard dry rosin; spirits unwarmed, and even wood.

5. Lightning sometimes dissolves metals: so does electricity.

6. Lightning rends some bodies: the same does electricity. Dr. Franklin observes, that the electric spark would strike a hole through a quire of paper.

7. Lightning has often been known to strike people blind. And a pigeon, after a violent shock of electricity, by which the doctor intended to

\* A glass that contains an accumulation of electric matter.

have killed it, was observed to have been struck blind likewise.

8. Lightning destroys animal life. Animals have likewise been killed by the shock of electricity. The largest animals, which Dr. Franklin and his friends had been able to kill, were a hen, and a turkey which weighed about ten pounds.

To demonstrate, in the clearest manner possible, the sameness of electrical fire with the matter of lightning, Dr. Franklin, astonishing as it must have appeared, contrived actually to bring lightning from the heavens, by means of an electrical kite, which he raised when a storm of thunder was perceived to be coming on.

This kite had a pointed wire fixed upon it, by which it drew the lightning from the clouds. The lightning descended along the hempen string that held the kite, and was received by a key tied to the extremity of it; that part of the string which the doctor had in hand, being of silk,\* that the electric fire might stop at the key, and not reach his body.

He found, that the string would conduct electricity even when nearly dry, but that, when it

\* Some bodies conduct the electric fire, and some do not conduct it. Silk is of the latter kind.

was wet, it would conduct it quite freely ; so that it would stream out plentifully from the key, at the approach of a person's finger.

At this key he charged phials, and from electric fire thus obtained, he kindled spirits, and performed all the common electrical experiments.

Q. Was not this discovery, of the sameness of lightning and electricity, applied by Dr. Franklin to a most useful purpose ?

A. It certainly was, namely, to the securing buildings from the dreadful effects of lightning in a thunder storm ; for as to the thunder itself, or the sound or noise we hear, it is perfectly harmless ; it is the lightning alone that does the mischief.

Q. How did he effect this ?

A. Only by fixing a pointed iron rod higher than any part of the building, and joining to the lower end of it a wire, which communicated with the earth, or rather the nearest water. This rod the lightning was sure to seize upon preferable to any other part of the building, and descended along it and the wire till it reached the earth, where it was instantly dissipated, without doing any harm.

Q. Ought not all public buildings, and especially all magazines, to have such an apparatus for defending them from lightning ?

A. They

*A.* They certainly ought, and many, I believe, have.

*Q.* Does lightning do great mischief in this cold climate of England?

*A.* Not frequently; yet such a thing sometimes happens, as was the case with St. Bride's church, in London, the steeple of which was damaged by a thunder storm in 1764.

*Q.* Is not the fire of electricity very different from common fire?

*A.* It is, and operates in a very different manner. It has been known to melt a sword in the scabbard without injuring the scabbard itself; and to melt money in a man's pocket without burning his cloaths. In a word, it seems to be of such a nature, that it can easily penetrate through porous bodies without affecting them, and spends all its force upon those that are hard and solid.

*Q.* May not the experiment of drawing lightning from heaven, by means of an electric kite, be attended with danger?

*A.* It no doubt may, and even actually has. It proved fatal to Abbé Richman, who, in 1753, was killed by a flash of lightning he drew down from the clouds, in an experiment he was making at Peterburgh.



Q. Has not electricity been applied to some medical purposes?

A. It has, and that too, it is said, with so much success, that it may now be considered as part of the science. We believe, however, that those who administer it, are rather looked upon by the rest of the faculty as so many quacks, as indeed the exhibitors of all new medicines are till their authority is firmly established.

Q. May not some electrical experiments be performed without the help of an electrical machine?

A. Yes, such as shew the attractive and repulsive power of bodies, but not such as produce lightning. Here follows one. Cut two bits of cork into the shape and size of a common pea. With a needle draw a thread through each of the corks, so that they may hang at the ends of the threads with a knot below them. Let the other ends of the threads be inserted in the notch of a small piece of wood, about a foot long, an inch broad, and of the thickness of a common match. Lay the piece of wood over the mouths of two wine glasses a few inches asunder, so that the end of it, in which the threads are, may project over the edge of the hither glass, and the corks may be in contact with one another. Take another wine glass; and having rubbed it heartily with a piece  
of

of flannel, or the skirt of a woollen coat, hold its mouth to within about an inch of the corks, and you will see them suddenly start and continue asunder for a considerable time.

Q. How does it appear that electricity has any share in producing earthquakes?

A. This has been already explained in page 22.

Q. You said, that in the opinion of some philosophers, the *Aurora Borealis*, or Northern Lights, are owing to electricity. Who are the philosophers that entertain this opinion?

A. Signior Beccaria, of Turin, was the first that advanced it. He thinks that the *aurora borealis* may be the electric matter performing its circulation in such a state of the atmosphere as renders it visible, or approaching nearer to the earth than usual.

He was followed in the same sentiments by Mr. Canton, our countryman, who says, that the *aurora borealis* may be the flashing of electric fire from positive towards negative clouds,\* at a great distance, through the upper part of the atmosphere, where the resistance is least. He supposes, that the *aurora borealis*, which happens at the time

\* Clouds are said to be positive when they have too much electricity, and negative when they have too little.

that

that the needle (in the mariner's compass) is disturbed by the heat of the earth, is the electricity of the heated air above ; and this, he says, will appear chiefly in the northern regions, as the alteration in the heat of the air in those parts will be the greatest.

This hypothesis, he adds, will not seem improbable, if it be considered, that electricity is now known to be the cause of thunder and lightning ; that it has been extracted from the air at the time of an *aurora borealis* ; that the inhabitants of the northern countries observe the aurora to be remarkably strong, when a sudden heat happens after severe cold weather ; and that the curious in these matters are now acquainted with a substance that will, without friction, both emit and absorb the electric fluid, only by the increase or diminution of its heat : meaning the Tourmalin, a singular kind of stone, the properties of which were about this time discovered.

Q. Is not electricity supposed to be the cause of many other phenomena besides those you have mentioned ?

A. Signior Beccaria thinks it is the cause of *water spouts*. To make this the more evident, he first describes the circumstances attending the appearance of these spouts. They are as follow.

They

They generally appear in calm weather. The sea seems to boil, and send up a smoke under them, rising into a hill towards the spout. At the same time, persons who have been near them have heard a rumbling noise. The shape of a water spout is that of a speaking trumpet, the wider end being in the clouds, and the narrower end towards the sea.

The size is various, even in the same spout.—The colour is sometimes inclining to white, and sometimes to black. Their position is sometimes perpendicular to the sea, sometimes oblique, and sometimes the spout itself is in the form of a curve. Their continuance is very various, some disappearing as soon as formed, and some continuing a considerable time. One that he had heard of continued a whole hour. But they often vanish, and presently appear again in the same place.

Q. Does not Beccaria likewise suppose, that whirlwinds and hurricanes are owing to electricity?

A. He does, and adds, that what water spouts are at sea, whirlwinds and hurricanes are by land. They have been known to tear up trees, to throw down buildings, make caverns in the earth; and, in all these cases, to scatter earth, stones, bricks, timber, &c. to a great distance in every direction. Great quantities of water have been left, or raised  
by

by them; so as to make a kind of deluge ; and they have always been attended with a prodigious rumbling noise.

That these phenomena depend upon electricity, cannot, he says, but appear very probable from the nature of several of them ; but the conjecture is made more probable from the following additional circumstances.

They generally appear in months peculiarly subject to thunder storms, and are commonly preceded, accompanied, or followed by lightning, rain, or hail. Whitish or yellowish flashes of light have sometimes been seen moving with prodigious swiftness about them. And, lastly, the manner in which they terminate exactly resembles what might be expected from the prolongation of an electrified cloud towards the sea ; the water and the cloud mutually attracting one another : for they suddenly contract themselves, and disperse almost at once ; the cloud rising, and the water of the sea under it falling to its level.

But the most remarkable circumstance, and the most favourable to the supposition of their depending upon electricity, is, that they have been dispersed by presenting to them sharp-pointed knives or swords. This, at least, is the constant practice of mariners, in many parts of the world where these

water

water spouts abound; and he was assured, he says, by several of them, that this method has often been attended with success.

Q. I think I have heard it said, that the meteor we usually call a falling star, is an electrical appearance: is it so?

A. It probably is, and the fact, which Signior Beccaria mentions in confirmation of this opinion, is very curious and remarkable.

As he was one time sitting with a friend in the open air, an hour after sun-set, they saw what is called a falling star directing its course towards them, and apparently growing larger and larger, till it disappeared not far from them; when it left their faces, hands, and cloaths, with the earth, and all the neighbouring objects, suddenly illuminated with a diffused and gentle light, attended with no noise at all.

While they were starting up, standing, and looking at one another, surprised at the appearance, a servant came running to them out of a neighbouring garden, and asked them if they had seen nothing; for that he had seen a light shine suddenly in the garden, and especially upon the streams which he was throwing to water it.

*FINIS.*



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